2003/04 New Zealand Total Diet Survey

Agricultural Compound Residues, Selected Contaminants and Nutrients

NEW ZEALAND FOOD SAFETY AUTHORITY

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2003/04 New Zealand Total Diet Survey

Conducted by the Institute of Environmental Science & Research Limited as part of a New Zealand Food Safety Authority contract for scientific services

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Summary

The 2003/04 New Zealand Total Diet Survey was carried out for the New Zealand Food Safety Authority by the Institute of Environmental Science & Research Limited. Previous NZTDSs have been carried out in 1974/75, 1982, 1987/88, 1990/91 and 1997/98.

The New Zealand Food Safety Authority (NZFSA) is committed to continuing to undertake Total Diet Surveys, recognising such studies as an important tool for monitoring dietary exposures to chemical residues, contaminants and nutrient elements. It is also recognised that contributing data, where appropriate, to the WHO Global Environmental Monitoring System (GEMS) is important. Promotion of a common international basis for conducting such surveys facilitates international comparison and consumer understanding of the relevance of the results.

The 2003/04 New Zealand Total Diet Survey (NZTDS) sampled and tested foods for a representative range of chemical residues, contaminants and nutrient elements that reflect likely dietary exposure pathways for different classes of chemical hazards in the New Zealand food supply. The 2003/04 NZTDS enables NZFSA to:

- assess the status of certain compounds in the New Zealand food supply
- indicate any potential exposure concerns and target any necessary risk management or risk communication
- demonstrate trends in dietary exposure
- make comparisons with exposure estimates derived in other countries.

The 2003/04 NZTDS involved sampling 121 different foods, of which 110 represented at least 70% of the most commonly consumed food items for the majority of New Zealanders, and analysing these foods to determine the concentrations of agricultural chemical residues, selected contaminants (arsenic, cadmium, lead and mercury) and nutrient elements (iodine, iron, selenium and sodium). Changes to the food list since the 1997/98 NZTDS included the addition of infant formulae and weaning foods, as well as other foods such as muffins, caffeinated energy drinks, flavoured milk, strawberries, grapes and snack bars to reflect changing dietary consumption. Foods were allocated into 12 food groups – Alcohol; Beverages, non alcoholic; Chicken, eggs, fish and meat; Dairy; Fruits; Grains; Infant weaning foods; Nuts; Oils and fats; Spreads and sweets; Takeaways; and Vegetables. This was to enable comparison with previous NZTDSs and to identify food groups that were likely to contain specific agricultural compound residues, and contaminant or nutrient elements.

Two-weekly simulated typical diets using these 121 foods were derived mainly from food frequency and 24 hour diet recall data from the 1997 National Nutrition Study for adults 15+ years and the 2002 Children's Nutrition Study for 5-14 year olds (both commissioned by the New Zealand Ministry of Health). Data from recent studies were used to simulate typical diets for children younger than five years of age.

The two-weekly simulated typical diets were established for the following eight age-sex groups, three of which were established for the first time in the 2003/04 NZTDS:

- 25+ year male (M)
- 25+ year female (F)
- 19-24 year young male (YM)
- 11-14 year boy (B), (new in 2003/04)
- 11-14 year girl (G), (new in 2003/04)
- 5-6 year child (C)
- 1-3 year toddler (T)
- 6-12 month infant (I) (new in 2003/04).

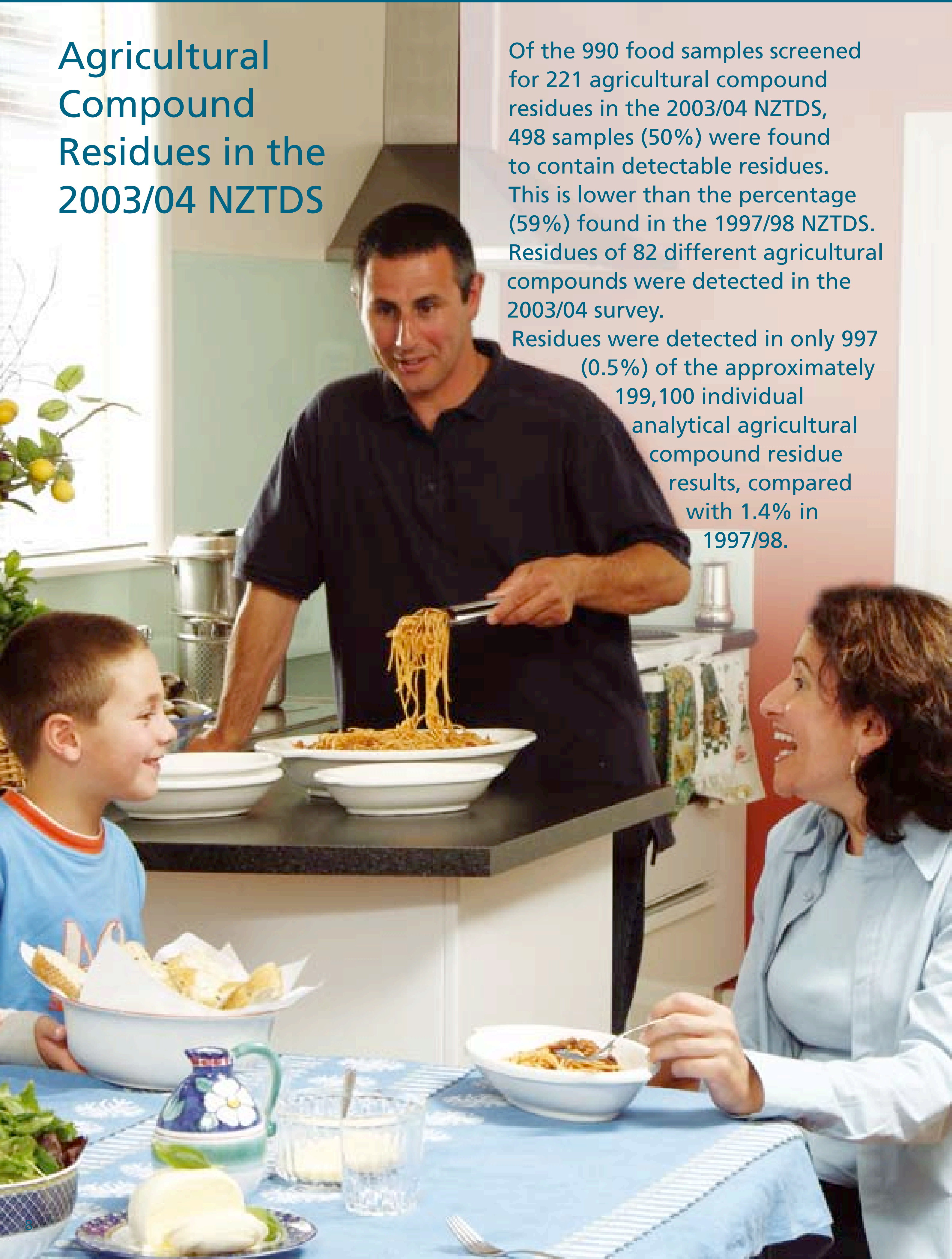
From these two-weekly diets, the weight of each individual food item consumed was determined for each age-sex group.

The 121 foods were, for the purpose of sampling, split into two groups – one comprising 63 national foods and the other 58 foods sampled on a regional basis. National foods are those that are either manufactured in one location and distributed throughout New Zealand, or imported and distributed nationally (such as bananas and sultanas). All national foods were purchased in supermarkets in Christchurch as the geographical region where national foods were purchased is presumed to have no bearing on the levels of agricultural compound residues, contaminant or nutrient elements in the product. Regional foods may potentially vary in their agricultural compound residue, contaminant or nutrient element levels, so regional foods were sampled in four centres – Auckland, Napier, Christchurch and Dunedin.

Foods sampled were intended to be typical of what was available at the point of sale. All foods were bought at two different times of the year to provide a measure of seasonal variation. The sampling protocol used in the 2003/04 NZTDS followed international best practice.

Approximately 4,440 different food samples were purchased in the 2003/04 NZTDS. Most of these were composited to provide a total of 968 different food samples for elemental analyses, and 990 samples for agricultural compound residue analyses. As with the last three NZTDSs, all foods in the 2003/04 NZTDS were prepared ready for consumption, prior to analysis. The analysis of the prepared samples was undertaken in accredited laboratories using internationally accepted methodologies, and a number of quality control requirements (including blanks, duplicates, spike recovery and/or Certified Reference Materials, and control samples) were used to ensure confidence in the robustness of the results.

Agricultural Compound Residues in the 2003/04 NZTDS



Of the 990 food samples screened for 221 agricultural compound residues in the 2003/04 NZTDS, 498 samples (50%) were found to contain detectable residues. This is lower than the percentage (59%) found in the 1997/98 NZTDS. Residues of 82 different agricultural compounds were detected in the 2003/04 survey.

Residues were detected in only 997 (0.5%) of the approximately 199,100 individual analytical agricultural compound residue results, compared with 1.4% in 1997/98.

Estimated dietary exposures to agricultural compound residues for the eight age-sex group simulated typical diets in the 2003/04 NZTDS were all well below the relevant Acceptable Daily Intake (ADI). Ninety percent of these, dietary exposures were less than 0.1% of the ADI. Of these, 66% had zero exposure because there were no detectable residues, and 24% of the residue exposures were between 0% and 0.1% of ADI. For the remaining dietary exposures, 5.2% were between 0.1 and 1% of ADI, 2.7% between 1 and 5% of ADI, and 0.5% between 5 and 20% of the ADI.

The highest estimated dietary exposures were for dithiocarbamate (DTC) fungicides. For adults, these ranged from 0.6 to 8%, and for children/infants from 1.2 to 19% of ADI. The upper bound range represents a worst case conservative estimate as it is based on the lowest available DTC ADI (ie the most toxic) of 3µg/kg body weight/day for thiram and ziram. The degree of overestimation could be as much as a factor of ten if all DTCs actually present were from the group with the highest ADI (30 µg/kg body weight/day, which includes mancozeb and metiram).

Thiram, ziram, mancozeb and metiram are all registered for use in New Zealand and the internationally accepted analytical methods employed in this survey are unable to differentiate which DTC is being detected. In addition, current DTC methodology is unable to differentiate DTCs from natural compounds in some vegetables (eg brassicas). Apparent residues on brassicas contribute approximately 43 to 51% of the total estimated exposure to DTCs for adults and 20 to 35% for infants/children. The actual dietary exposure is likely to be within the upper and lower bounds.

It is NZFSA's assessment that the agricultural compound residue levels found in this survey are highly unlikely to have any adverse health implications for the New Zealand population. This conclusion is drawn from the comparison of the findings of this survey with internationally recognised Acceptable Daily Intake (ADI) values, which are based on chronic, lifetime exposure.

Contaminant Elements in the 2003/04 NZTDS

The estimated weekly dietary exposures to arsenic, cadmium, lead and mercury for the eight age-sex group simulated typical diets in this survey were all well within the Provisional Tolerable Weekly Intakes (PTWIs) set by the World Health Organization.

Foods in the 2003/04 NZTDS analysed for total **arsenic** had concentrations consistent with documented international levels. Fish products (fresh fish, canned fish, battered fish, mussels and oysters) contributed 90% of weekly total arsenic exposure for the young male diet and 85% for the toddler diet. International studies have demonstrated that most (>90%) of the arsenic present in fish is in the relatively non-toxic organic form.

Using the conservative assumptions that 10% of total arsenic in fish/seafood is inorganic, and that 100% of total arsenic in all other foods is inorganic, the weekly dietary exposures to inorganic arsenic for the eight age-sex groups of the 2003/04 NZTDS were all less than 17% of the PTWI for inorganic arsenic.

Cadmium

Estimated weekly dietary exposures in New Zealand are strongly influenced by the inclusion of oysters in the simulated typical diet (19-24 year young male – 1.8 µg/kg body weight/week including oysters, 1.3 excluding oysters).

Oysters, breads and potatoes were identified as the major sources of dietary cadmium. These all have cadmium concentrations higher than those generally reported overseas.

Nevertheless, weekly dietary exposure to cadmium for the 19-24 year young male (diet including two to three oysters per fortnight) is 26% of the PTWI, and well down on the 40% of the PTWI in the 1997/98 NZTDS. With oysters excluded from the simulated diet, the weekly dietary exposure to cadmium for the 19-24 year young male drops from 24% of the PTWI in 1997/98 to 18% of the PTWI in 2003/04.

The other dietary exposures to cadmium in the 2003/04 NZTDS range from a low of 20% of the PTWI for the 11-14 year girl to 37% for the 5-6 year child and 1-3 year toddler. (The non-adult simulated typical diets do not include oysters).

Cadmium dietary exposure in the 2003/04 NZTDS for an adult male (diet including oysters) are below those of the Republic of Korea, similar to those of the Czech Republic, and above those of Australia, the USA, the UK, France and the Basque Country. If oysters are excluded from the diet, the 2003/04 NZTDS exposures to cadmium for the 25+ year male are then below or similar to all countries except France.

NZFSA acknowledges that consumption of certain types of oysters has the potential to significantly increase the body's cadmium load.

Lead

Estimated weekly dietary exposures have again reduced for all age-sex groups since the 1997/98 NZTDS, to 3.8% of the PTWI for the 19-24 year young male (compared with 103% in 1982), and 12% of the PTWI for 6-12 month infants. The continued decrease in dietary lead exposures can probably be attributed to the complete removal of lead additives from retail petrol since 1996.

The individual foods contributing to dietary lead exposure were spread evenly over the food groups and reflect the ubiquitous environmental presence of residual lead in New Zealand.

Almost all foods in the 2003/04 NZTDS had similar or lower levels of lead than in 1997/98, apart from one marked exception. The 2003/04 NZTDS identified a major lead contamination episode in the New Zealand food supply, initially found in baby food (0.8 mg/kg), but traced back to cornflour (23 mg/kg lead). This resulted in food recalls in New Zealand, Australia and Fiji.

The 2003/04 NZTDS lead exposure for adult male (0.9 µg/kg bw/week) is one of the lowest levels when compared to Australia (1.6), USA (1.0), France (1.9), the Czech Republic (3.0) and the Basque Country (2.9). It is more than ten times below exposures reported for the Republic of Korea (21.2) and China (13.8).

Mercury

Estimated weekly dietary exposures for all age-sex groups were 26% or less of the PTWI for total mercury, and 86% or less of the PTWI if all mercury is assumed to be methylmercury.

Fish products contributed 74% of the dietary mercury exposure for a young male and 65% for a toddler.

Estimated weekly dietary exposure to mercury for a young male in the 2003/04 NZTDS (0.74 µg/kg bw/week) was almost identical to the 1997/98 NZTDS (0.73) despite a rise in fish/seafood consumption in the 2003/04 (250 g/week) diet compared to 1997/98 (175 g/week).

It is NZFSA's assessment that the contaminant element dietary exposures found in the 2003/04 NZTDS are highly unlikely to have any adverse health implications for the New Zealand population. This conclusion bears in mind that PTWIs have safety factors (SF) built into them (for cadmium, SF=3), and that PTWIs in themselves represent a level of no appreciable risk for lifetime exposure.

It is noted, however, that dietary exposures in the 2003/04 NZTDS were based on mean energy diets for each of the age-sex groups. High consumers have the potential to have significantly higher exposures, and in some instances the targeting of public health messages may be appropriate. Similarly, for some age-sex groups or specific sub population's public health messages may also be appropriate. An example already in place relates to dietary exposures to mercury, with public health messages aimed at women of child-bearing age and caregivers of toddlers and infants, and recommendations made on which fish to eat, and the frequency and amounts of those fish.

Nutrient Elements in the 2003/04 NZTDS

Iodine

The iodine content of most foods was less than 0.05 mg/kg. There were three foods with particularly elevated iodine content, namely a brand of soy milk (9.14 mg/kg), mussels (3.34 mg/kg) and oysters (1.38 mg/kg). The level in the soy milk was unexpected and unacceptably high. Soy milk normally has less than 0.01 mg/kg iodine and elevated levels were due to the use of seaweed in the formulation of one particular product. This product was reformulated by the manufacturer when it was advised of the finding.

The estimated mean daily intakes of iodine in the 2003/04 NZTDS were significantly lower than the Recommended Daily Intake (RDI) for all age-sex groups. Iodine intake varied from only 40% of the RDI for a 25+ year female to 57% of the RDI for a 25+ year male.

It should be noted that the dietary iodine intakes of this survey (and any previous NZTDSs) are likely to be underestimated because discretionary salt used during cooking or at table for taste was not considered.

A combination of dairy foods and other animal sources (eggs, mussels, fresh fish and oysters) provided the majority of the iodine in the diet of a 25+ year male and female, 19-24 year young male, and 11-14 year boy and girl. Dairy foods make the most significant contribution to iodine intake for a 1-3 year toddler (67%). Intake of iodine for a 6-12 month infant is dominated by levels in infant weaning foods.

Mean daily intakes of iodine in New Zealand have steadily declined over the past 20 years and are low compared with intakes in the UK, Denmark and The Netherlands.

The low dietary intakes of iodine in New Zealand are a concern. NZFSA and the New Zealand Ministry of Health have undertaken targeted work on iodine over recent years. The fortification of the New Zealand and Australian food supply with iodine is currently under review by Food Standards Australia New Zealand. Monitoring of iodine will continue in future NZTDSs.

Iron

The concentration of iron in most foods is less than 50 mg/kg. The highest concentration of iron was found in yeast extract and lambs liver at 446 and 435 mg/kg respectively. A number of cereal products, mussels and oysters had maximum iron levels above 100 mg/kg.

Mean daily intakes of iron for a 25+ year male, 19-24 year young male, and 11-14 year boy and girl are between the RDI and upper intake limit. Intake for a 25+ year female, 5-6 year child, 1-3 year toddler and 6-12 month infant are below the RDI, with the lowest intake seen for a 25+ year female who on average is consuming only 51% of the RDI of iron.

Grains and red meat (beef and lamb) are important contributors to iron intake for a 25+ year male and female, 19-24 year young male, and 11-14 year boys and girls. Wheat biscuit cereals, yeast extract, white bread and cornflakes are the major contributors to intake for a 1-3 year toddler, and infant weaning foods, yeast extract and wheat biscuit cereals are the major contributing foods for a 6-12 month infant.

Mean iron intake for a 25+ year female has changed little over the past 20 years, even with the recent permitted fortification of grain products, while iron intake for a 19-24 year young male has decreased by approximately 25% during the past ten years.

Although bioavailability of dietary iron found in this survey was not assessed, the 2003/04 NZTDS does provide useful baseline information given that some products are now fortified with iron. NZFSA therefore anticipates future monitoring for iron will be undertaken.

Selenium

Calculated daily dietary intakes of selenium for all age-sex groups of the 2003/04 NZTDS meet or are slightly below the RDI. Across each population group selenium intakes have been steady over a 20 year period. By international standards, intake of selenium in New Zealand falls within the middle range.

Seafood, chicken, eggs, breads and grain products provide the majority of selenium in the diets of all age-sex groups included in the 2003/04 NZTDS, except for the 6-12 month infant for whom infant weaning foods contribute nearly 30%.

The selenium content of breads suggests a geographical difference, with South Island (Christchurch and Dunedin) breads containing less selenium than North Island (Auckland and Napier) breads.

NZFSA's assessment is that selenium intakes do not pose a risk to the health of the New Zealand general population. However, those living in the South Island and in low selenium areas are likely to have lower dietary intakes of selenium and continued monitoring in future NZTDSs can therefore be expected.

Sodium

The concentration of sodium in the 121 foods of the 2003/04 NZTDS ranged from <10 to 42,000 mg/kg with the highest level measured in a yeast extract. Higher sodium concentrations are found in processed than unprocessed foods. For example, the mean concentration of sodium in pork is 838 mg/kg compared with 15,250 mg/kg in bacon.

Mean daily sodium intakes are significantly above the adequate intake for all age-sex groups and exceeded the upper intake limits for all groups except the 25+ year female. For the 19-24 year young male, intakes were 157% of the upper intake limits.

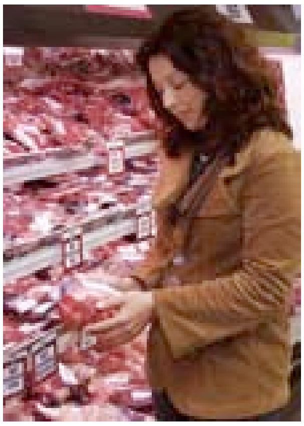
The single greatest contributor to sodium intake is bread accounting for 15 to 27%, followed by processed meats (bacon, ham, corned beef and sausages) contributing 10 to 14% of total sodium intake. Processed grain products collectively account for 33 to 48% of sodium intake.

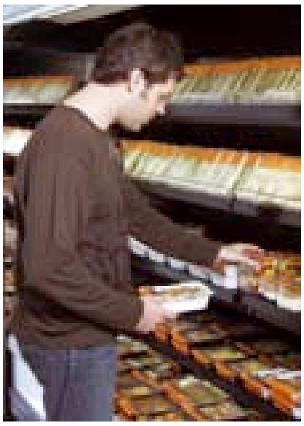
The sodium intake estimates in the 2003/04 NZTDS do not include the use of discretionary salt, added at the time of cooking or at the table for taste, and it is has been estimated this could add up to an additional 25% to total sodium intake.

Estimated sodium intake has decreased for a New Zealand 25+ year male and female, 19-24 year young male and 1-3 year toddler by 8 to 17% for the period 1987 to 2003.

The mean daily sodium intake by New Zealand age-sex groups are higher than those for the UK, France and the USA.

NZFSA's view on dietary exposure to sodium is consistent with the recommendations of the Ministry of Health Food and Nutrition Guidelines. These guidelines support a reduction in the sodium intake of the New Zealand population. Therefore future monitoring for dietary exposure to sodium can be expected.





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1 INTRODUCTION

1.1 What are Total Diet Surveys?

Total Diet Surveys (TDSs) enable us to estimate and monitor dietary exposures to chemical residues, contaminant and nutrient elements.

A TDS involves purchasing (at retail level) foods commonly consumed by the population, preparing them as for normal consumption, homogenising and compositing them, before analysing the foods for the chemicals of interest (WHO, 2005).

Total diet surveys differ from other chemical surveillance programmes because:

- they assess exposure to chemicals across the total diet in the one study, in contrast to food commodity surveys where only a few individual foods are generally investigated
- a defining characteristic of a TDS is that actual concentrations of chemicals are measured in foods after they have been prepared as for normal consumption. For this reason, total diet surveys provide, in general, the most accurate estimate of dietary exposures to chemical residues for a country as a whole; and thus the best means of assessing the potential risk to the consumer. Concentration data in a TDS is not based on historical composition data, and processing factors for raw food commodities do not need to be estimated because, for example, bananas are peeled, the skin discarded along with any associated chemical residues, and estimated exposures based on the edible flesh. A TDS also takes into account the impact of cooking on less stable chemicals, and the possible formation of new chemical compounds
- a TDS needs to measure down to the lowest concentrations of the chemicals in the foods to provide concentration data useful for meaningful dietary exposure estimates. These concentrations are generally 10-1,000 times lower than those needed for regulatory purposes. The extremely low limits of detection (LOD) needed and the procedure for assigning concentration data to 'not detected' results are critical to exposure estimates in a TDS (see also sections 2.3 and 2.4).

1.2 Importance of Total Diet Surveys

Total Diet Surveys (TDSs) are considered important for monitoring dietary exposures to chemicals, and the associated risk to public health. This is the main reason why most developed countries conduct TDSs on a regular basis. A TDS is undertaken every year in the United States, approximately every three years in the United Kingdom, and every four years for contaminant elements in Australia. Previous NZTDSs have been carried out in 1974/75, 1982, 1987/88, 1990/91 and 1997/98.

Unsafe levels of chemicals in food also have the potential to pose threats to trade and the environment. It is estimated that the global economic and trade burden from contaminants in the food supply total many billions of dollars annually (FAO/WHO, 2003). A TDS is able to provide accurate information on a population's actual total dietary exposure to chemicals in our diet.

In addition, the results from a TDS can be indicators of environmental contamination by chemicals and can be used to assess the effectiveness of specific risk management measures, so monitoring trends over TDSs is both useful and important.

The 2003/04 NZTDS dietary exposures and concentration data for agricultural chemicals, and selected contaminant and nutrient elements, provide important information for New Zealand and other international authorities as to the quality and safety of the New Zealand food supply. One such key group is the World Health Organization (WHO), who through its Global Environmental Monitoring System (GEMS)/Food programme collects and evaluates data from food commodity surveys and TDSs of different countries. New Zealand is currently actively involved in this programme, and continued support and involvement is important to enable access to a wider range of international comparative data, and is included as one of the defined goals of this NZTDS.

1.3 Goals of the 2003/04 New Zealand Total Diet Survey

The 2003/04 NZTDS was carried out for the New Zealand Food Safety Authority (NZFSA) by the Institute of Environmental Science & Research (ESR).

The agreed goals for the 2003/04 NZTDS were to:

- agree in consultation with stakeholders the design and content of the 2003/04 NZTDS
- estimate dietary exposure for selected chemical residues, contaminant and nutrient elements in the New Zealand food supply, compare this with internationally recognised acceptable exposures or recommended levels, and identify trends in New Zealand over time
- compare dietary exposure estimates with those in other countries, where comparable data are available
- ensure that the outcomes of the NZTDS complement data on chemical residues, contaminant and nutrient elements generated from other sources in New Zealand
- where appropriate, provide data on selected chemical residues, contaminant and nutrient elements for incorporation into other databases, including the World Health Organization (WHO) Global Environmental Monitoring System (GEMS), and the New Zealand Food Composition Database
- communicate findings in a timely and transparent manner.

1.4 History of the New Zealand Total Diet Survey

The 2003/04 NZTDS is the sixth such survey. In each of the TDSs, each type of regional food was sampled from four different geographic regions, so as to take into account different regional agricultural compound usage and the different levels of trace elements due to the varying soil conditions. Nationally distributed foods, including imported foods, were sampled in one city. Sampling was also carried out from each district on more than one occasion to take into account any seasonal variation in the foods.

The first two TDSs, undertaken in 1974/75 (Dick et al, 1978 a,b) and 1982 (Pickston et al, 1985) by the then Department of Health and DSIR Chemistry Division (later ESR), were based on a food group composites approach. Foods of a similar type, for example fruits, were combined in proportions relative to their level of consumption in the diet of an active adolescent male. Individual food items were not analysed. A more detailed explanation of the sampling protocols can be found in the appropriate publications.

In the 1987/88 NZTDS (ESR/MoH, 1994), the design was changed to an individual foods approach. For each of the 105 foods involved, a total of 24 samples were obtained to provide a broad sampling base and yielded a total of 2,520 samples. The 24 samples were composited (a subsample from each of the 24 samples was taken and combined) to give one analytical sample for each of the 105 foods. In addition, the diet for the young male was now based on a median (50th percentile) energy diet, and specific diets were developed for a wider range of age-sex groups (adult male, adult female, child, young child). Foods were prepared table ready (for example, the meat was cooked).

The 1990/91 NZTDS (Vannoort et al 1995 a,b; Hannah et al, 1995; Pickston and Vannoort, 1995) and 1997/98 NZTDS (Cressey et al, 2000; Vannoort et al, 2000) both continued the individual food approach. In 1990/91, the food list had increased to 107 foods, and included drinking water, and in 1997/98 had been extended to 114 foods, and a lacto-ovo vegetarian female diet added.

1.5 The 2003/04 NZTDS and Changes in Approach Compared to 1997/98 NZTDS

The 2003/04 NZTDS was very similar to the 1997/98 NZTDS. Significant differences were:

- the food list was further increased to a total of 121 foods. Some foods were removed to reflect changes in dietary patterns since the previous NZTDS. These were the additions to the 2003/04 NZTDS of mainly infant weaning foods, extra fruits, such as strawberries and grapes, and muffins, flavoured milk and caffeinated energy drinks to reflect the increasing role they play in the New Zealand diet
- the revision of each of the simulated typical diets, including the addition of diets for a 6–12 month infant, 11–14 year male and female, while deleting the lacto-ovo vegetarian female diet. The revised diets generally reflected a higher overall energy intake, consistent with National Nutrition Survey (NNS) data for each age-sex group, compared to the diets used for the 1997/98 NZTDS
- extension of the range of agricultural compounds included in the multi-residue screen from 90 to 202 agricultural compounds and agricultural compound metabolites, and inclusion of an 18 compound acid herbicide screen
- extra emphasis on assessing iodine intakes, and inclusion of iron and sodium to the selected nutrients under investigation
- a wider sampling base, and significant increase in samples analysed from 460 to 990 for agricultural compound residues, and 532 to 968 for elements.

1.6 Structure of the 2003/04 NZTDS Reports

This is the main Report for the 2003/04 NZTDS, and it summarises the key findings regarding estimated dietary exposures to agricultural compounds, contaminant elements and nutrients. In addition, it provides a general introduction to the TDSs and the NZTDS, and details the methodologies used in the 2003/04 NZTDS.

An **Auxiliary Data** report (Vannoort and Thomson, 2005) has also been prepared, which contains the consolidated concentration data for all individual foods for all analyses in the 2003/04 NZTDS. In addition, it details the food preparation instructions, simulated diets, the agricultural compounds screened for and their limits of detection, the elements analysed and their limits of detection, and the analytical quality control procedures used in the 2003/04 NZTDS.

All analytical data for each food/analyte combination associated with the 2003/04 NZTDS has been released previously in four quarterly reports (Vannoort, 2003b; 2004a; 2004b; 2004c).

A procedures manual for the 2003/04 NZTDS has previously been prepared, including purchasing instructions and sample preparation instructions (Vannoort, 2003a).

Separate reports have also been produced detailing the 2003/04 NZTDS food list (Brinsdon, 2002), and the simulated typical diets (Brinsdon, 2004).

2 METHODS USED IN THE 2003/04 NEW ZEALAND TOTAL DIET SURVEY

2.1 Food Selection, Sampling and Preparation

The selection of foods for the 2003/04 NZTDS were based on those of the 1997/98 NZTDS, with minor changes to reflect the changing patterns of consumption during the intervening period. This resulted in 110 foods. An additional eleven foods were added because they are significant sources of contaminants or agricultural compounds, such as oysters, mussels and liver, or are popular for specific sub populations, especially children, such as infant foods and flavoured milk. The 121 foods of the 2003/04 NZTDS are likely to represent approximately 70% of the total foods consumed in New Zealand. Details of the Food List, showing changes from the 1997/98 NZTDS, are available elsewhere (Brindson, 2002).

The following food groups and numbers of contributing foods were selected: Alcohol (3), Beverages, non-alcoholic (3), Chicken, eggs, fish and meat (17), Dairy (9), Fruit (17), Grains (18), Infant weaning foods (4), Nuts (2), Oils and fats (3), Spreads and sweets (7), Takeaways (7) and Vegetables (26). A list of individual foods is given in **Appendix 1.**

Foods were classified as either National Foods or Regional Foods.

National Foods (63), which were not expected to exhibit any regional variability and included processed foods, such as biscuits, breakfast cereals and beverages, which are uniformly available throughout New Zealand.

National Foods were sampled in a single location (Christchurch) on two occasions (October/November 2003 and May/June 2004). Up to four brands, selected on the basis of market share, were collected on each sampling occasion. Foods were analysed on the basis of individual brands per season to give a total of four analyses for each food for each season, although occasionally the four brands from one season were composited to give one analysis for that food.

Regional Foods (58) that be expected to demonstrate variation in agricultural compound, contaminant and nutrient level depending on the location in which the food was produced. Regional foods include meat, milk, fruit and vegetables. Regional foods were sampled in each of four locations (Auckland, Napier, Christchurch and Dunedin)* on two occasions (July/August 2003 and January/February 2004). Foods were prepared and analysed on the basis of individual regions/season to give a total of four analyses for each food for each season, although occasionally the four regions were composited to give one analysis for each food each season.

Foods were prepared to a 'table ready' state before analysis. For example, meats and potatoes were cooked, while fruits that are normally consumed without peel, such as oranges and bananas, were peeled. All water used in food preparation was distilled. (Details of food preparation are given in the **Auxiliary Data** report**, Appendix 1**, Vannoort and Thomson, 2005).

* *Four sampling locations provide geographical spread across the country, with Auckland being the main population centre in the North Island, and Napier a key growing area in the North Island. Christchurch is the main population centre in the South Island, and Dunedin another South Island city, with different soil and climatic conditions.*

2.2 Simulated Diets of the 2003/04 NZTDS

Fourteen-day simulated typical diets were developed (Brinsdon, 2004) for eight selected population age-sex groups:

- 25+ year male (M)
- 25+ year female (F)
- 19-24 year young male (YM)
- 11-14 year boy (B)
- 11-14 year girl (G)
- 5-6 year child (C)
- 1-3 year toddler (T)
- 6-12 month infant (I).

The main data sources were the 1997 National Nutrition Survey (NNS97) conducted for New Zealanders 15 years and older (Russell et al, 1999) and the 2002 Children's Nutrition Survey (CNS02) for children 5–14 years of age (MoH, 2003), and recent surveys of young children (Soh et al, 2002; Wall personal communication, 2004). Industry groups were contacted to confirm selected changes in consumption patterns.

Diets were created to resemble an average consumer in each of the selected groups and included all appropriate foods from the food list (ie children's diets do not contain alcohol).

Consistent with previous NZTDSs, the 19–24 year young male was selected as a group with a high total energy intake for the New Zealand population (Russell et al, 1999) and therefore highest exposure to food contaminants and agricultural compound residues. The diets for the 25+ year male and female were chosen to represent the average adult population, and for consistency with previous NZTDSs. Older persons were not included as a separate group because their overall consumption patterns were similar to adults based on a review of the NNS97.

Diets for a 5-6 year child and 11-14 year boy and girl were selected as representative of food intakes for young people based on results from the Children's Nutrition Survey (CNS02, MoH, 2003). There was little gender difference for the 5-6 year old, but sufficient difference in the adolescents to warrant both a male and female diet for 11-14 years. Previous NZTDSs included a 4-6 year old diet, which has been replaced in the 2003/04 NZTDS with 5-6 years, and 1-3 years. In the absence of any national studies of food and nutrient consumption in preschool children, diets for the 1-3 years were derived from regional studies (Soh et al, 2002; Wall personal communication, 2004; Watson et al, 2001; Weber, 1997). The infant group was seen as a valuable addition to the NZTDS as their low body weights in comparison with energy intake places them at a potentially higher risk than the adult population. With infants relying on a more limited range of foods for their nutrition, a contaminant found in a key food for infants could be potentially problematic for infant consumers.

The weights of each individual food estimated to be consumed by each age-sex group in the 2003/04 NZTDS are listed in **Auxiliary Data** report, **Appendix 2**, (Vannoort and Thomson, 2005).

A summary of the body weights, total weight of diet and estimated energy intakes of the simulated diets for each age-sex group in the 2003/04 NZTDS is given in **Table 1**, along with comparative data for 1997/98.

Body and total diet weights have increased for each adult age and gender group, for which there is comparative data, reflecting the increasing food consumption trend in the New Zealand population. This is particularly marked for the young male, who has increased in mean body weight from 70 to 78 kg. Children's weights are based on measured national data, and children's diets based on regional studies compared with Food and Nutrition Guideline values used in the previous 1997/98 NZTDS.

Table 1 Age-sex groups and body weights, total weight of diet and energy intakes of the simulated diets for 2003/04 and 1997/98 NZTDS

Age-sex group	Body weight (kg)		Total weight of diet (g/day)		Energy (MJ)	
	2003/04	(1997/98)	2003/04 [e]	(1997/98) [f]	2003/04 [e]	(1997/98) [f]
25+ yr male (M)	82 [a]	(80)	3461	(2797)	11.9	(9.8)
25+ yr female (F)	70 [a]	(65)	2779	(2608)	8.2	(6.8)
19-24 yr young male (YM)	78 [a]	(70)	3173	(2817)	13.8	(11.5)
11-14 yr boy (B)	54 [b]	-	2042	-	10.4	-
11-14 yr girl (G)	55 [b]	-	1790	-	8.5	-
5-6 yr child (C)	23 [b]	(20) [d]	1633	(1961) [d]	7.2	(6.6) [d]
1-3 yr toddler (T)	13 [c]	-	1275	-	5.2	(4.7)
6-12 month infant (I)	9 [c]	-	1044	-	3.8	-

a NNS, 1997 (Russell et al., 1999)
b CNS, 2002 (MoH, 2003)
c NHMRC, 2005 (draft)
d 4-6 year old
e Derived from 1997 NNS survey data (Brinsdon, 2005)
f Derived from 1990 Life in New Zealand survey data (Brinsdon, 1999)

2.3 Analytes

The following criteria were used to decide if a food was analysed in the 2003/04 NZTDS for certain analytes, and whether these were analysed as an individual regional / brand composite per season; or as a seasonal composite:

- high contributor to exposure from WHO GEMS
- high contributor to exposure from 1997/98 NZTDS
- high concentration in 1997/98 NZTDS
- limit of detection (LOD) in respective matrices
- key food(s) /food groups covered for new analytes (ie acid herbicide screen)
- available budget, recognizing differential costs for agricultural compounds, elements and moisture
- increased individual analyses from 1997/8 NZTDS to 2003/04.

Foods in the 2003/04 NZTDS were analysed up to 221 agricultural compound residues (see 2.3.1 below for details) and eight elements, including the four nutrient elements, iodine, iron, selenium and sodium, and the four contaminant elements, arsenic, cadmium, lead and mercury. A full list of analytes is available in the **Auxiliary Data** report**, Appendix 3** and **4**, (Vannoort and Thomson, 2005).

A number of quality assurance procedures, including blanks, duplicates, certified reference materials, spikes and blind duplicates, were included to ensure confidence in the methodology and robustness of the results. Details are available in the **Auxiliary Data** report**, Appendix 5**, (Vannoort and Thomson, 2005).

2.3.1 Agricultural compounds

Three groups of agricultural compound analyses were included in the 2003/04 NZTDS, namely a multi-residue screen of 202 agricultural compounds, a specific test for dithiocarbamate (DTC) fungicides, and a specific test for 18 acid herbicides.

All foods in the 2003/04 NZTDS were screened for 202 agricultural compounds and metabolites in the multi-residue agricultural compound screen, with four different regional samples per season. In addition, 46 fruit and vegetable products were analysed for DTC fungicides, each food product with four different regional samples per season. Selected foods: apples, mixed grain bread, infant foods (4), milk 3.25% fat, peas, potatoes, strawberries and tomatoes; were prepared as seasonal composites and analysed for 18 acid herbicides. Bacon, beef mince, chicken, egg, lamb/mutton, soy milk and water were prepared as individual composites and analysed for the presence of 18 acid herbicides.

The multi-residue screen was achieved by an ethyl acetate extraction followed by purification by gel permeation chromatography and detection and quantification by gas chromatography mass spectrometry (GCMS). Internal standards were used to give an accurate determination of residue levels.

Foods for analysis of DTC residues were decomposed in acid conditions to form carbon disulphide, which was then measured spectrophotometrically.

For the analysis of eighteen acid herbicide residues, an acidic ethyl acetate extraction was followed by gel permeation, derivitisation with diazomethane and detection and quantification by GCMS.

The limits of detection (LOD) varied for different agricultural compounds and different foods. For the multi-residue and DTC agricultural compounds, the LOD was generally 0.01 mg/kg, or lower. For the acid herbicides, the LOD was 0.02 mg/kg for most foods. Agricultural compounds, and their LODs, are listed in the **Auxiliary Data** report **, Appendix 3** (Vannoort and Thomson, 2005).

2.3.2 Elements

Foods were acid digested to release the elements arsenic, cadmium, iron, lead and mercury. The diluted digests were analysed by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), for each element except iron for which Inductively Coupled Plasma-Optical Emission Spectroscopy (ICP-OES) was used. Mercury was detected by Flow Injection Mercury System (FIMS). Samples requiring selenium or iodine were alkaline digested and analysed by ICP-MS.

The limit of detection (LOD) for elements varied from 0.0005-50 mg/kg depending on the element, the fat and the water content of the food. Details are available in **Auxiliary Data** report**, Appendix 4** (Vannoort and Thomson, 2005).

2.4 Calculation of Mean Concentration Data in the 2003/04 NZTDS

The primary focus of the NZTDS is to estimate dietary exposure. Exposures are estimated by multiplying mean concentration data by the amount of food consumed. Mean concentration data would normally be rounded, but the mean is an intermediate in the calculation of the estimated dietary exposure, so rounding has been left to the final calculated figure.

While a very wide sampling base for each food in the NZTDS is desirable, the number of analytical samples for each food is usually a compromise depending on the range of analytes to be covered, the size of the food list, and the resources available for the project. The number of analytical samples and summary concentration data for foods with detectable residues in the 2003/04 NZTDS are included in the **Auxiliary Data** report**, Appendices 6** to **9** (Vannoort and Thomson, 2005).

2.4.1 Agricultural compound mean concentration data in 2003/04 NZTDS

Mean concentrations of agricultural compounds in 2003/04 NZTDS foods were calculated as simple arithmetic means. Agricultural compounds are intentionally applied to crops at specific times to achieve a specific purpose. Agricultural compound residues may be present at a detectable level, may be present at a level below the limit of detection (LOD), or may not be present. Where no residue was detected in the sample, the true concentration of the agricultural compound in that sample was assumed to be zero, an assumption that will be valid in most cases. This is the most commonly used international protocol for estimating dietary exposure to agricultural compounds (FAO/UNEP/WHO, 1985; Gunderson, 1995; FSANZ, 2003). Residues above the LOD have been reported and used for determining mean concentrations in the 2003/04 NZTDS.

The United States Environmental Protection Agency (US EPA) takes a slightly modified approach; zero values are assigned to "the proportion of the data set corresponding to the percentage of commodities known not to be treated with the pesticide" (US EPA, 1998). The necessary information to follow this approach is not currently available in New Zealand.

2.4.2 Contaminant and nutrient element mean concentration data in the 2003/04 NZTDS

Contaminant and nutrient elements are naturally occurring and ubiquitous. They thus occur in food, as well as throughout the environment in soil, air and water. For this reason, a 'not detected' result means there is a high probability of contaminant and nutrient elements being present but at such a level that they cannot be detected. To assume that the 'not detected' level implies a zero value for the contaminant or nutrient element would underestimate the total level in the diet. Conversely, to assume that 'not detected' values are all present at the limit of detection (LOD) would overestimate the total level in the diet.

For contaminant and nutrient elements, when estimating an arithmetic mean concentration, a 'not detected' result was allocated the value of half the limit of detection (ND=LOD/2) in **Auxiliary Data** report, **Appendices 8** and **9** respectively, (Vannoort and Thomson, 2005). This maintains consistency of approach with previous NZTDSs, and the approach recommended by the 1995 Global Environmental Monitoring System/Food Euro workshop (WHO GEMS/Food-Euro, 1995). For a concentration above the LOD, the actual concentration generated by the ICP-MS in the 2003/04 NZTDS has been used. For completeness of dietary exposure/intake estimates for contaminant and nutrient elements, lower bound (ND=0) and upper bound (ND=LOD) mean concentrations were also determined.

Similar 'non-zero' protocols for 'not detected' results are in use by other countries around the world. The Basque Country (Jalon et al, 1997) assigned a value equal to LOD to 'not detects'. In contrast, China (Chen and Gao, 1993 a,b) have assigned the value of zero to 'not detected' contaminant element results for the purpose of calculating dietary exposures. The UK (UK FSA, 2004) and USA (Egan et al, 2002) use both lower and upper bound estimates. Australia (FSANZ, 2003) uses the statistical middle value (median) for contaminant elements because it is not dependent on the treatment of results below the limit of quantitation.

2.5 Estimating Dietary Exposures in the 2003/04 NZTDS

In order to obtain the best estimate of total dietary exposures for each analyte, a mean concentration was needed for each of the 121 foods in the 2003/04 NZTDS.

The estimates of dietary exposures were calculated by using the arithmetic mean concentration of the particular agricultural compound, contaminant or nutrient elements in food (**Auxiliary Data** report**, Appendices 6**, **8** or **9**; Vannoort and Thomson, 2005) multiplied by the daily weight for each food consumed (derived from two week simulated diets) for each age-sex group (**Auxiliary Data** report**, Appendix 2**; Vannoort and Thomson, 2005). This then produced dietary exposures on a µg/kg body weight/day basis.

Agricultural compound residue exposures in the 2003/04 NZTDS expressed in this format can be found in **Appendix 2** of this report.

For contaminant elements, international convention is in a µg/kg bw/week, and these were obtained by multiplying the total daily exposure by seven. Estimated dietary contaminant exposures in the 2003/04 NZTDS are given in **Table 7** of this report.

For nutrient elements, international convention is on a per person per day basis, so daily exposures were multiplied by body weight **(Table 1)** to obtain nutrient intakes for the 2003/04 NZTDS **(Table 16)**.

It should also be noted that the estimated dietary exposures to agricultural compound residues, contaminant or nutrient elements in this report are based on average energy consumption figures. Generally, high consumers at 95th percentile levels may approximate three times the population average consumption figure for individual foods, and up to twice the total amount consumed by the population as a whole (FAO/UNEP/WHO, 1985).

3 AGRICULTURAL COMPOUND RESIDUES: RESULTS AND DISCUSSION

3.1 Introduction

Agricultural compounds are used widely in agriculture (Holland and Rahman, 1999). Their application has improved crop yields and has increased the quantity of fresh fruits and vegetables available to the consumer (NRC, 1993). Agricultural compounds may also cause harm. If the dose is sufficiently high, some agricultural compounds can cause a range of adverse effects on human health, including acute and chronic injury to the nervous system, lung damage, reproductive dysfunction, possibly cancer, and dysfunction of the endocrine and immune systems (NRC, 1993). However, foods produced in accordance with good agricultural practice (GAP) should not contain levels of agricultural compound residues from which adverse effects are likely to result.

Agricultural compound residues are usually present in foods as the result of intentional application to crops or stored food products for a defined purpose at a particular time. While levels of nutrients in foods are relatively well established in food composition databases (Athar et al, 1999), the agricultural compound content of foods can vary significantly over time and from place to place. The analyses included in NZTDSs allow temporal and geographical trends to be examined.

Agricultural compounds fall into a number of generic classes, and these are detailed below, along with their chemical structure, historical development, their stability in the environment, and ability to accumulate up the food chain, their mode of action, and effects of acute and chronic toxicity.

The 2003/04 NZTDS analysed foods for residues of the following classes of agricultural compounds:

- persistent organochlorine agricultural compounds
- organophosphorus agricultural compounds
- fungicides
- other agricultural compounds.

The other agricultural compounds class includes synthetic pyrethroids (analogues of the naturally-occurring pyrethrins), some herbicides, synergists (compounds which are applied in conjunction with other agricultural compounds to increase their effectiveness), carbamates, post-harvest sprout inhibitors and any other agricultural compound which does not fit in the preceding three major categories.

3.1.1 Estimated dietary exposure to agricultural compounds

The level of agricultural compound exposure is compared with the Acceptable Daily Intake (ADI), which is the level at or below which there will be no appreciable risk of adverse health effects, if consumed over an entire lifetime. Thus the health implications are assessed from the perspective of chronic toxicity, and with exposures at the ADI, by definition therefore, representing a very low level of risk (Winter et al, 1997).

ADIs are set using the information obtained from toxicological studies, including data from chronic studies on various laboratory animals. From these studies, a no observable adverse effect level (NOAEL) is established. The NOAEL is the highest dose level that produces no observable adverse effect in the most sensitive test species. The NOAEL is divided by a safety factor, taking into account the difference between test animals and humans, and the difference between individuals, to give the ADI expressed in terms of mg agricultural compound/kg body weight/day. Safety factors for agricultural compounds are usually in the range 100 to 1,000, depending on the reliability and interpretation of the toxicological data available.

Safety factors lower than 100, down as low as 10, may be used if good human epidemiological data are available, but this is rarely the case. New Zealand usually adopts ADIs recommended by the Joint WHO/FAO Meeting on Pesticide Residues (JMPR). The most recent ADIs promulgated by JMPR are included in **Appendix 2**, and have been expressed on µg/kg bw/day basis for ease of reading.

3.1.2 Trends in estimated dietary exposure to agricultural compounds

The 2003/04 NZTDS is the sixth carried out in New Zealand. While there were significant changes in the survey design between the 1982 NZTDS (Pickston et al, 1985) and the 1987/88 NZTDS (ESR/MoH, 1994), the procedures for performance of the NZTDS have been fairly consistent for the last four surveys (1987/88, 1990/91, 1997/98 and 2003/04). Therefore, changes in estimated dietary exposure from one survey to the next can be assumed to reflect:

- changes in usage patterns of agricultural compounds; or
- changes in food consumption patterns; or
- changes in analytical procedures allowing detection of a wider range of agricultural compounds, or the same agricultural compounds, but at previously undetectable levels.

These trends will be reported for the main agricultural compounds detected in the 2003/04 NZTDS.

3.1.3 International comparisons of estimated dietary exposure to agricultural compounds

The results of the 2003/04 NZTDS have been compared with the 20th (2000/01) Australian Total Diet Study (ATDS; FSANZ, 2003) and the 2000/01 United States Total Diet Studies (Egan, 2005). There are a limited number of TDSs available for comparison and these two studies were selected for the cultural similarities between these countries and New Zealand and because the methodologies for estimating exposure are comparable.

Comparison of estimated dietary exposure to agricultural compounds for the New Zealand population with estimates made in other countries can be problematical due to differences in:

- analytical procedures, including limits of detection
- agricultural practices
- analytical quality assurance/quality control
- TDS design (individual foods or food group composites)
- definition of age-sex groups and body weights used
- protocols for dealing with 'not detected' analytical results
- diets (different foods, levels of consumption)
- ethnic differences.

Because of these factors it is considered less appropriate to compare absolute numbers between studies. Consequently, comparisons with international studies have, in general, been presented graphically as this enables relative orders of magnitude to be recognised more easily.

Comparisons with international TDSs have been made against estimated dietary exposures calculated for the New Zealand adult male (25+ years, 82 kg body weight). The overseas studies and the relevant age-sex group for comparison are given in **Table 2** below. While the international studies include a number of age-sex groups, some of the comparative studies for the contaminant and nutrient elements only calculate exposures for an 'average adult' or an 'average adult male'. The adult male was viewed as the best compromise for comparability with other studies.

3.2 Agricultural Compound Results Overview

Of the 990 food samples screened for 221 agricultural compound residues, 498 samples (50%) were found to contain detectable residues. This is lower than the percentage (59%) found in the 1997/98 NZTDS (Cressey et al, 2000), despite the current survey employing a much wider agricultural compound screen (221 agricultural compounds vs 90 in 1997/98), in addition to some of the same compounds being analysed down to lower detection limits in 2003/04.

A total of 82 different agricultural compound residues were detected out of the 221 agricultural compounds screened for in the 2003/04 NZTDS. By way of comparison, the 2000/01 (20th) Australian Total Diet Study (ATDS) reported detection of 36 different agricultural compound residues out of a total of 92 screened for (FSANZ, 2003). The list of agricultural compound residues screened for, but not detected, in the 2003/04 NZTDS is in **Appendix 3.**

The different food types containing the highest number of agricultural compound residues were raisins/sultanas (18), cucumber (16), muesli, tomato and capsicum (12), celery (11), apples and bran cereal (10), sausages, jam, canned apricots (7), and strawberries (6); although for each food type, these were not all in the same sample. The maximum number of agricultural compound residues in any one food sample from the 2003/04 NZTDS was nine, on imported raisins/sultanas, but it should be noted that this sample was a composite of four 250 g packets. The list of foods with no agricultural compound residues detected in the 2003/04 NZTDS can be found in **Appendix 4**.

Of the approximately 199,100 individual analytical agricultural compound residue results, 997 results (0.5% cf 1.4% in 1997/98) represented detectable residues.

Only eight of the 221 agricultural compound residues screened for accounted for 580 (58%) of the 997 detectable residues. These were pirimiphos methyl (138 detections), DDE-4,4' (109), DTCs (82), chlorpyriphos methyl (65), iprodione (60), diphenylamine (56), fenitrothion (35), and procymidone (35).

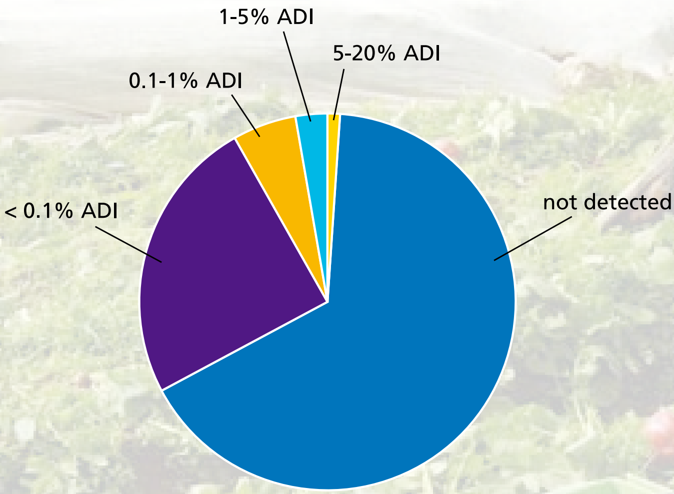
Table 2 Overseas TDSs used for comparison with results from the 2003/04 NZTDS

Country	Name of survey	Age-sex group	Body weight (kg)	Age (years)
New Zealand	2003/04 New Zealand Total Diet Survey	adult male	82	25+
Australia	2000/01 (20th) Australian Total Diet Study (ATDS; FSANZ, 2003)	adult male	82	25-34
United States	2000/01 Total Diet Studies (Egan, 2005)	adult male	80	25-30

The estimated dietary exposures to the agricultural compound residues detected in the diets of the eight age-sex groups of the 2003/04 NZTDS are summarised in **Appendix 2.**

In fact, 24% of the estimated dietary exposures to agricultural compound residues for the eight age-sex groups in the 2003/04 NZTDS were less than 0.1% of the ADI, 5.2% between 0.1 and 1% of the ADI, 2.7% between 1 and 5% of the ADI, and 0.5% possibly between 5 and 20% of the ADI, whereas 66% were zero (not detected). These are depicted in **Figure 1**.

Figure 1 Dietary exposures to agricultural compound residues in the 2003/04 NZTDS as a percentage of the ADI



The estimated dietary exposures in the 5-20% of ADI category were for DTC fungicides. For adults, these ranged from 0.6-8%, and for children/infants from 1.2-19% of the ADI (see **Appendix 2**). The upper bound end of each range represents a worst case conservative estimate as it is relative to the lowest available DTC ADI of 3 µg/kg body weight/day for thiram.
The degree of overestimation in dietary exposure as a percentage of ADI could be as much as a factor of ten if all DTCs actually present were from the group with the highest ADI (30 µg/kg body weight/day, which includes mancozeb). Both thiram and mancozeb are registered for use in New Zealand and current international analytical methods, as employed in this survey, do not differentiate which DTC was being detected. In addition, current DTC methodology is unable to differentiate DTCs from natural compounds in some vegetables (eg brassicas). Apparent residues on brassicas, including those from natural compounds, contributed approximately 20-35% of the total estimated exposure to DTCs for infants/children, and 43-51% for adults.

The estimated dietary exposures to agricultural compound residues for each of the age-sex groups in the 2003/04 NZTDS are depicted in **Figures 2-9**, for those agricultural compounds at greater than 0.4% of the ADI. It is clear that all estimated dietary exposures are very much lower than the ADI, and therefore do not represent a risk to the health of the general New Zealand public.

Figure 2 Estimated daily dietary exposures to agricultural compound residues for a 25+ year male in the 2003/04 NZTDS

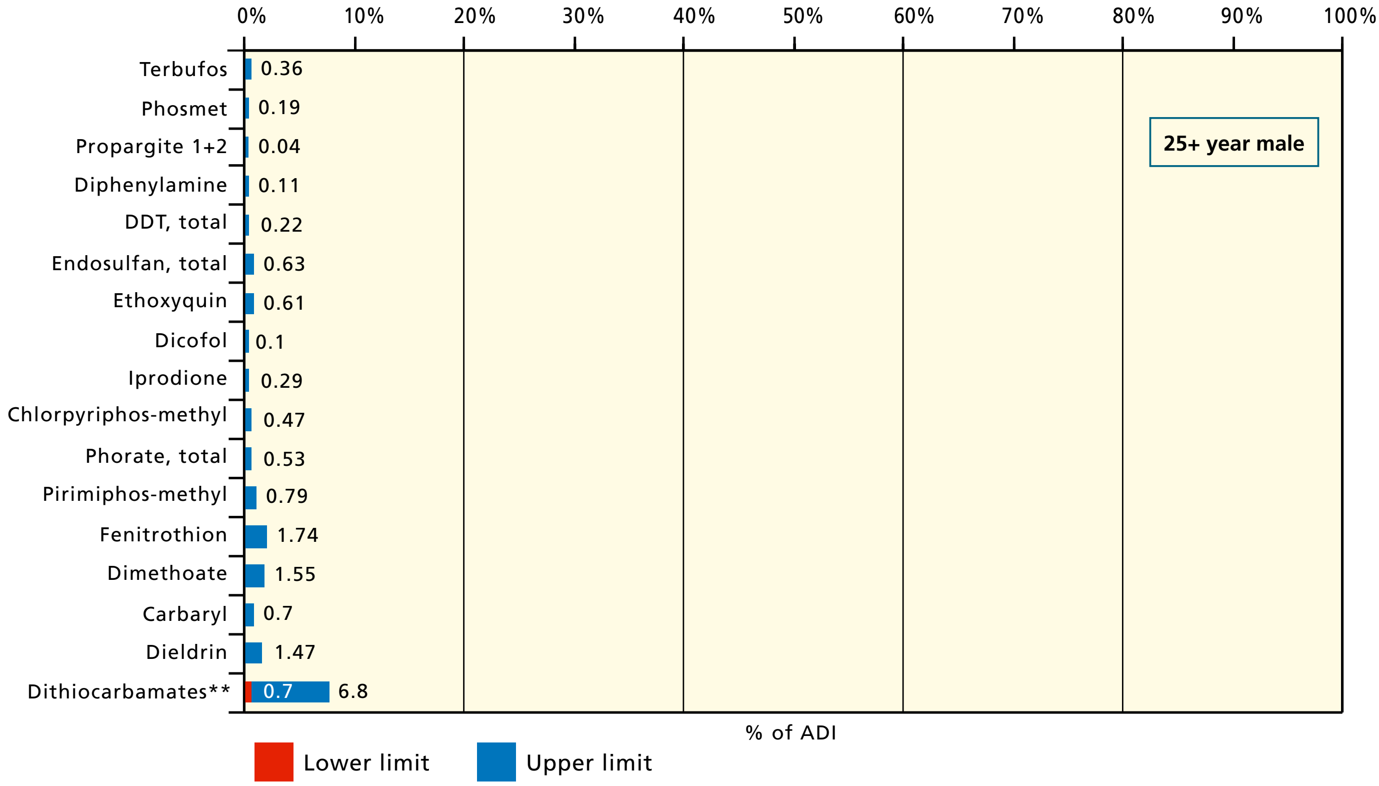
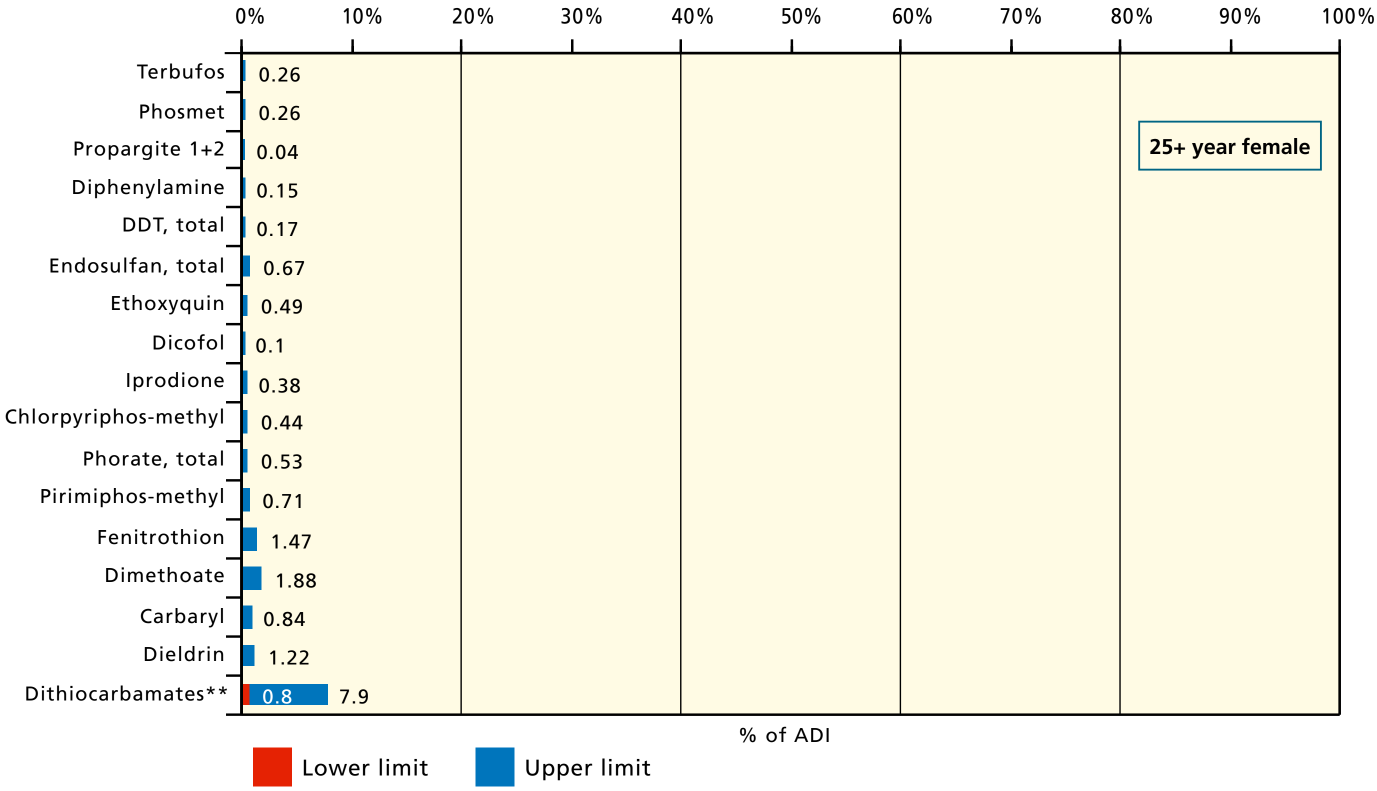


Figure 3 Estimated daily dietary exposures to agricultural compound residues for a 25+ year female in the 2003/04 NZTDS



* Only those agricultural compounds with dietary exposures >0.4% of ADI in the 2003/04 NZTDS have been graphed

** Red colour in bottom of bar graph for DTCs shows lower range exposure estimate, blue shows upper range

Figure 4 Estimated daily dietary exposures to agricultural compound residues for a 19-24 year young male in the 2003/04 NZTDS

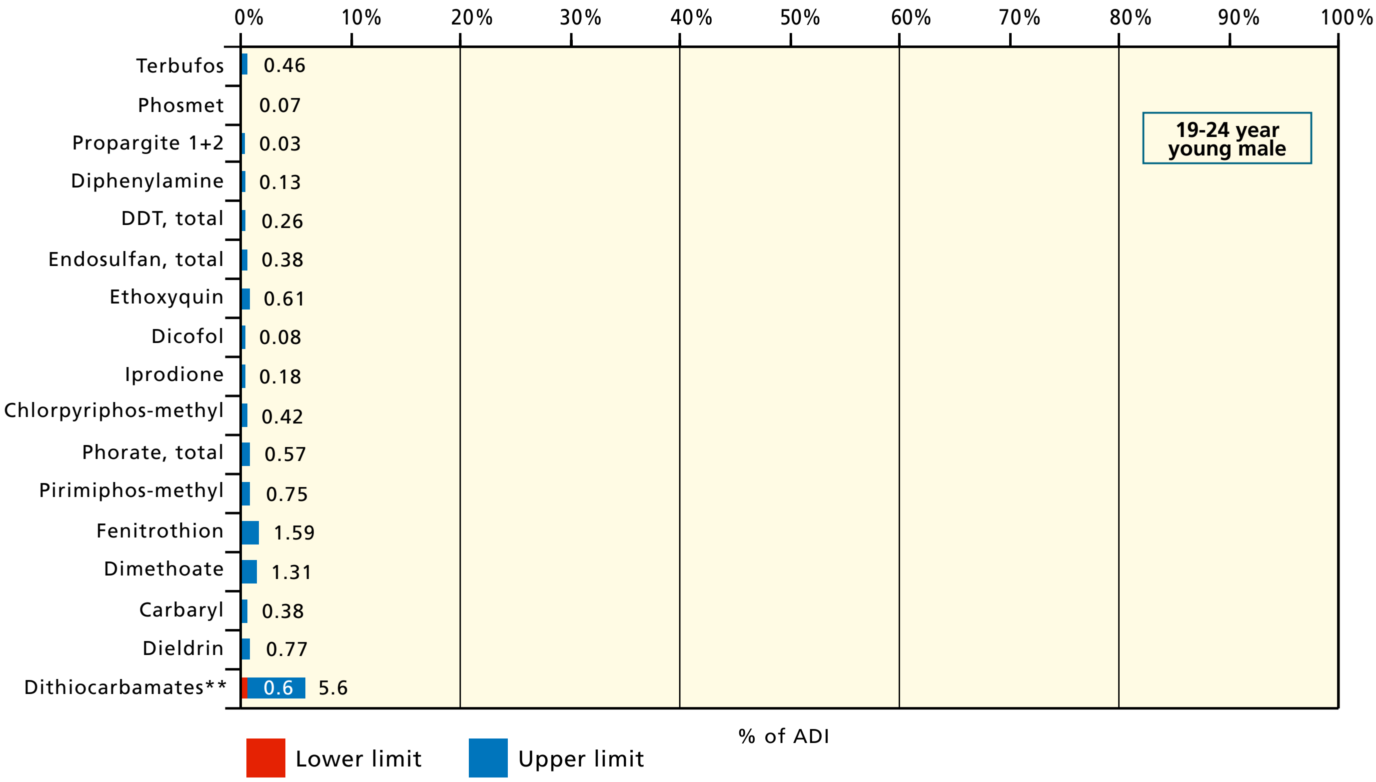
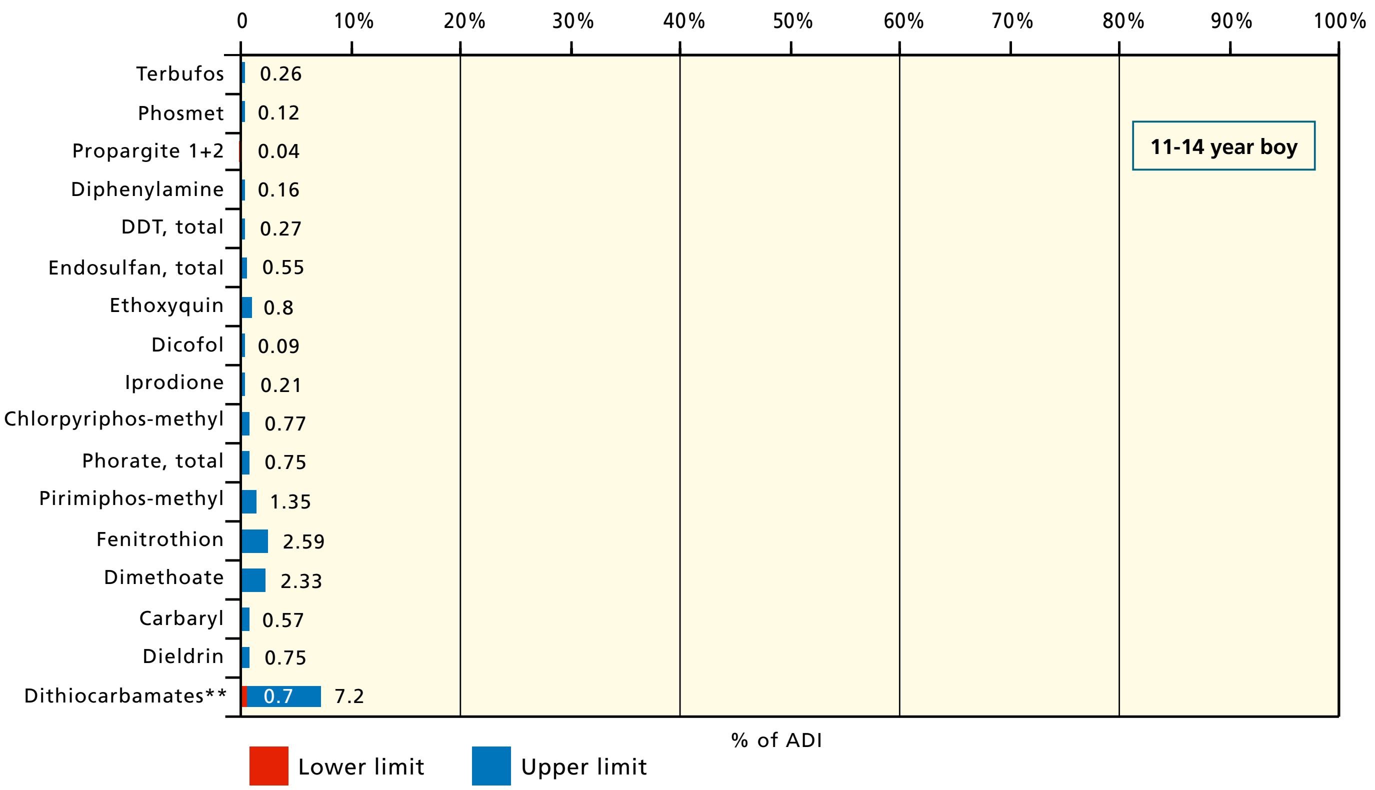


Figure 5 Estimated daily dietary exposures to agricultural compound residues for an 11-14 year boy in the 2003/04 NZTDS



* Only those agricultural compounds with dietary exposures >0.4% of ADI in the 2003/04 NZTDS have been graphed
** Red colour in bottom of bar graph for DTCs shows lower range exposure estimate, blue shows upper range

Figure 6 Estimated daily dietary exposures to agricultural compound residues for an 11-14 year girl in the 2003/04 NZTDS

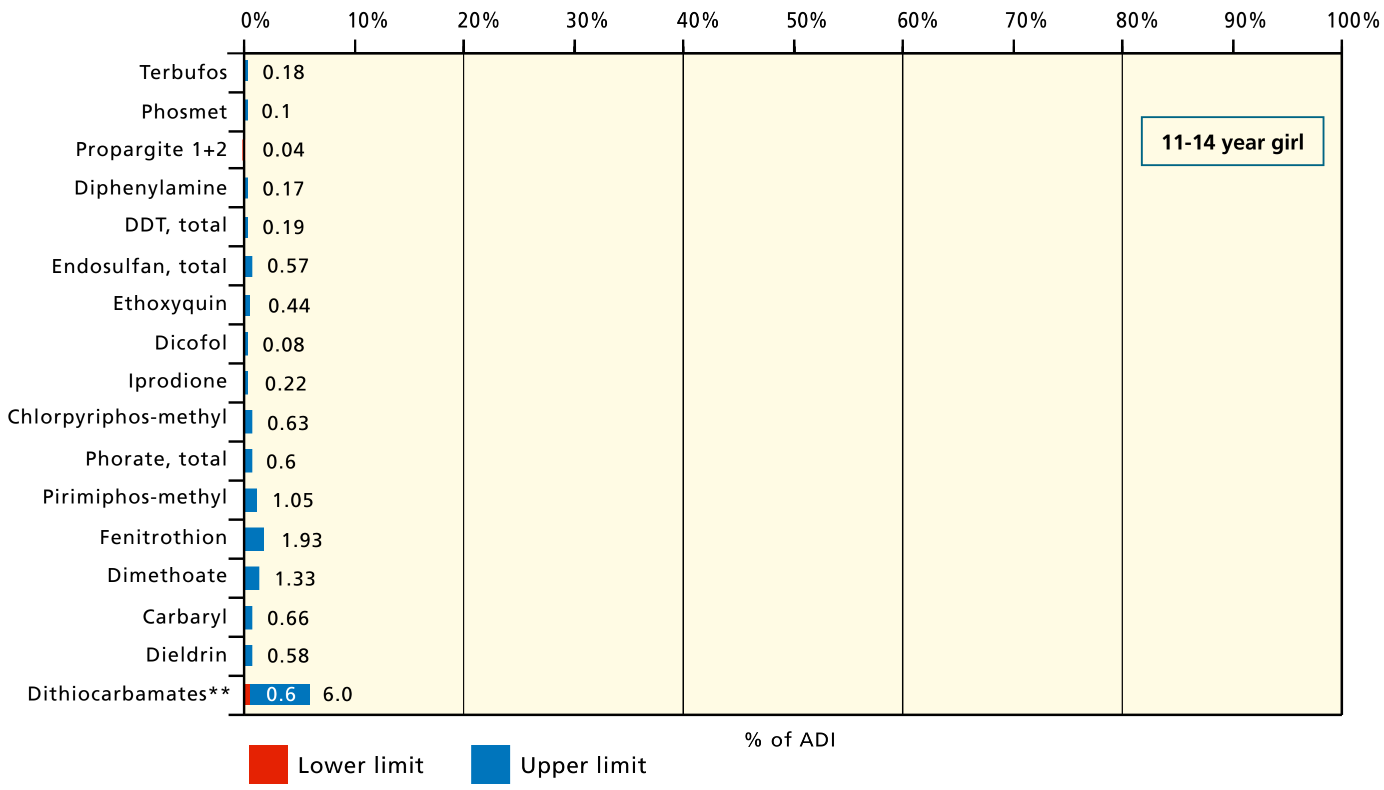
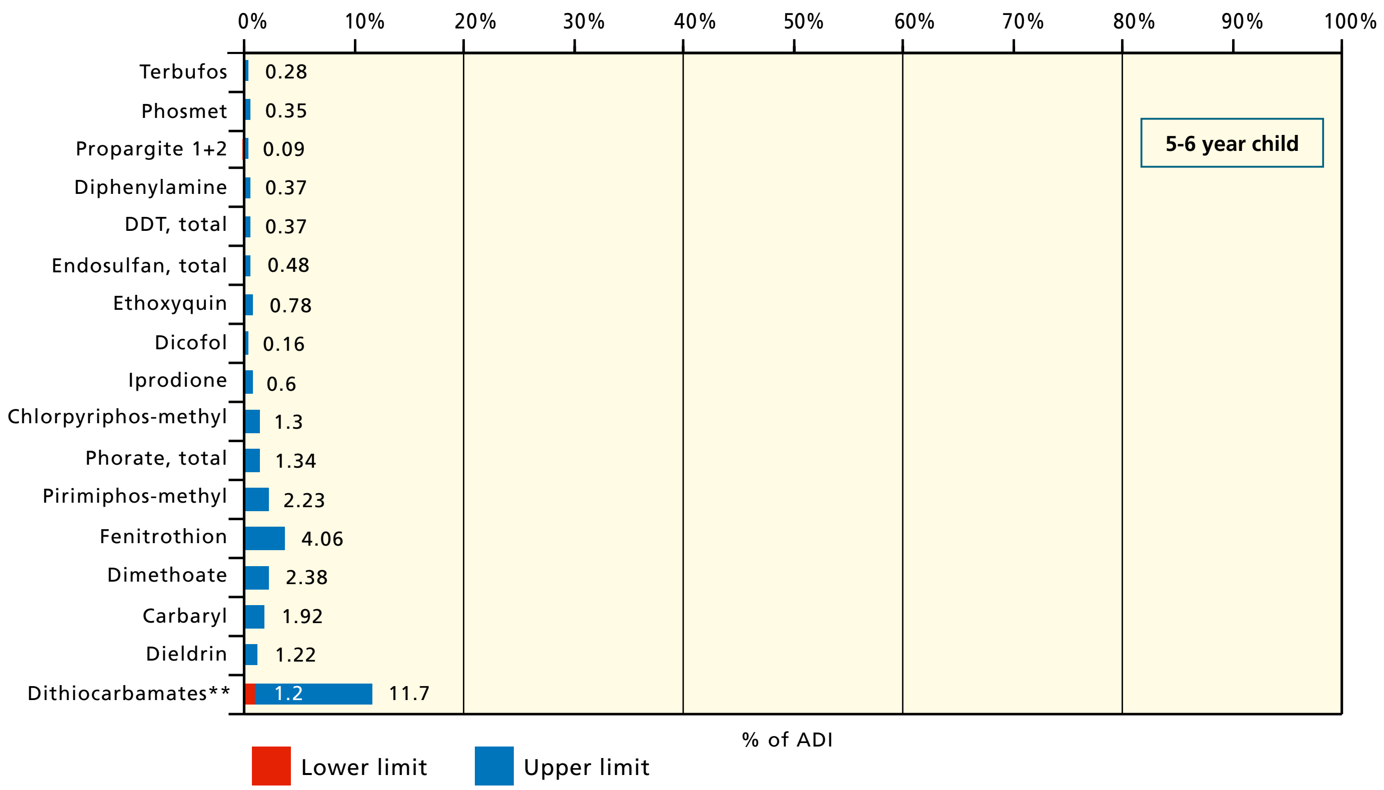


Figure 7 Estimated daily dietary exposures to agricultural compound residues for a 5-6 year child in the 2003/04 NZTDS



* Only those agricultural compounds with dietary exposures >0.4% of ADI in the 2003/04 NZTDS have been graphed

** Red colour in bottom of bar graph for DTCs shows lower range exposure estimate, blue shows upper range

Figure 8 Estimated daily dietary exposures to agricultural compound residues for a 1-3 year toddler in the 2003/04 NZTDS

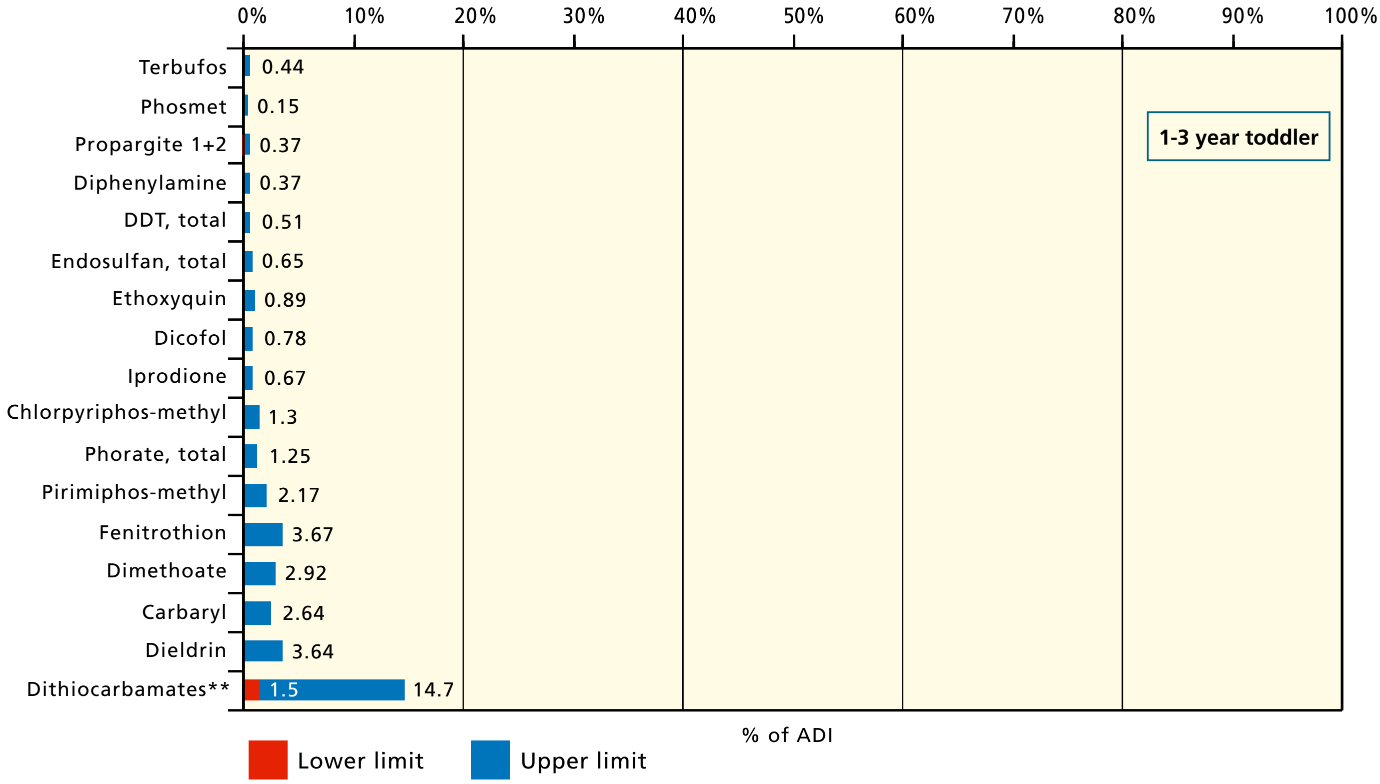
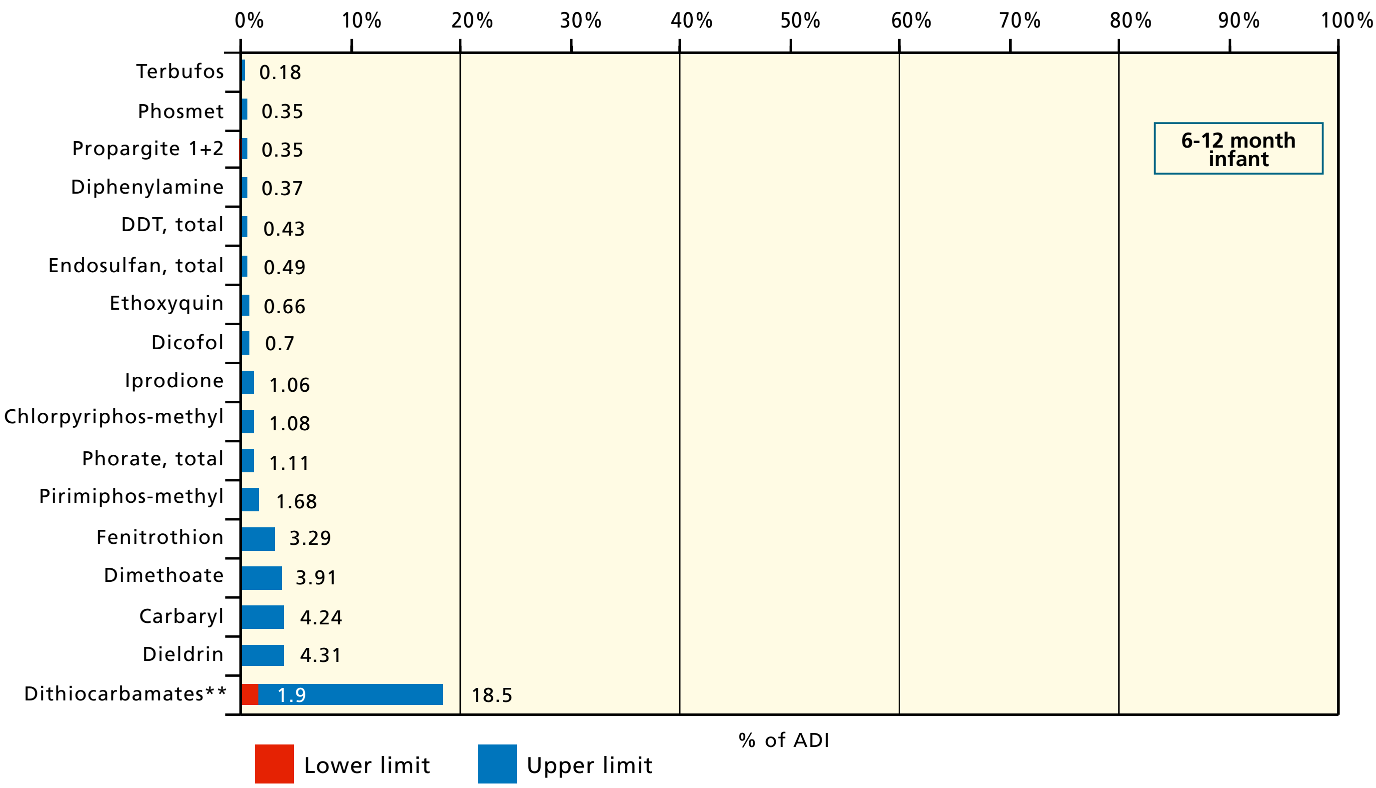


Figure 9 Estimated daily dietary exposures to agricultural compound residues for a 6-2 month infant in the 2003/04 NZTDS



* Only those agricultural compounds with dietary exposures >0.4% of ADI in the 2003/04 NZTDS have been graphed
** Red colour in bottom of bar graph for DTCs shows lower range exposure estimate, blue shows upper range

3.3 Persistent Organochlorine (OC) Agricultural Compound Residues

Organochlorine agricultural compounds were amongst the first of the modern agricultural compounds, developed during the 1930s (NRC, 1993). With notable exceptions, most organochlorine compounds have a relatively low toxicity to mammals and are highly toxic to insects. They can be very stable compounds and persist in soils. They are also fat-soluble and may be stored in the fat of humans and other animals. The majority of residues found in food are due to the persistence of compounds such as DDT or its metabolites. These compounds are more accurately classified as environmental contaminants than as agricultural compounds.

Organochlorines are effective as agricultural compounds by disrupting pests' nerve function. In mammals, acute poisoning (usually occupational exposure or suicide) can produce death by respiratory or cardiac failure as a result of nerve dysfunction. Chronic poisoning results in behavioural changes, liver damage and reduced reproductive efficiency (Jones, 1993).

ADIs for organochlorine agricultural compounds range from 0.1 µg/kg body weight/day for the highly toxic compounds aldrin, dieldrin and heptachlor, to 10 µg/kg body weight/day for total DDT and dicloran (IPCS, 2002).

The concentrations of organochlorine agricultural compounds in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b; 2004 a,b,c). This data is consolidated in the **Auxiliary Data** report, **Appendices 6** and **7** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of organochlorine agricultural compounds and the associated 2003/04 NZTDS foods, sorted either by agricultural compound (**Appendix 6**) or by the 2003/04 NZTDS food (**Appendix 7**).

Residues of two persistent organochlorine agricultural compounds, total DDT (116), and dieldrin (6), were detected in foods analysed in the 2003/04 NZTDS. Residues of these two organochlorine agricultural compounds account for 12% of all residues detected (122 out of a total of 997).

DDT has not been registered for agricultural use in New Zealand for over 15 years, although its general use on pasture was voluntarily discontinued 10-20 years prior to that. The major metabolite of DDT, DDE-4,4', was detected in a wide range of animal products and processed foods containing animal products. Residues of DDT were not detected in any plant-based foods of New Zealand origin, other than in 1 of 8 samples of silverbeet.

Exposure estimates from previous NZTDSs indicate that DDT is gradually decreasing in the New Zealand environment. **Table 3** presents comparative data from the 1987/88, 1990/91, 1997/98 and 2003/04 NZTDSs for the mean concentration of total DDT (parent compound plus major metabolites) in selected total diet foods.

While the mean concentrations presented in **Table 3** are based on relatively limited sample numbers, there does appear to be a general downward trend in the levels of these persistent compounds in New Zealand foods.

Table 3 Comparison of mean concentrations of total DDT in selected total diet foods analysed in the 1987/88, 1990/91, 1997/98 and 2003/04 NZTDSs

Food	Mean concentration of total DDT in selected NZTDS foods (mg/kg)			
	1987/88	1990/91	1997/98	2003/04
Bacon	0.03	0.02	0.006	0.005
Beef, rump	Trace [a]	0.01	0.002 [b]	0.005 [b]
Butter	0.07	0.04	0.020	0.023
Cheese	0.07	0.02	0.008	0.008
Chicken	Trace [a]	0.005 [b]	0.002 [b]	0.003
Lamb/mutton, shoulder	0.03	0.03	0.010	0.006
Lamb's liver	0.05	0.08	0.005	Not detected
Sausages, beef	0.03	0.03	0.020	0.010
Limit of detection	0.01	0.01	0.003	0.002

a Trace refers to situations where the analyte was detected, but could not be accurately determined

b Reported results which are below the limit of detection are the result of averaging results above the limit of detection and results below the limit of detection (assigned a value of zero)

3.3.1 Estimated dietary exposure to persistent organochlorine agricultural compounds

Estimated daily dietary exposures to persistent organochlorine agricultural compounds for each of the age-sex groups considered in the 2003/04 NZTDS are given in **Appendix 2**. Results are presented as exposures expressed as µg/kg body weight/day, and as a percentage of the relevant ADI, as ADIs differ between persistent organochlorine agricultural compounds.

Figures 2-9 include the estimated daily dietary exposures to the persistent organochlorine agricultural compounds for each of the eight age-sex groups in the 2003/04 NZTDS which were >4% of the ADI (dieldrin and DDT total). The highest exposures were observed for the 6-12 month infant. This is not unexpected because infants have the highest consumption of food and energy on a per body weight basis. Exposure estimates for the persistent organochlorine agricultural compounds detected for all age-sex groups in the 2003/04 NZTDS represent a very low level of risk.

In the 2003/04 NZTDS, the highest dietary exposures to persistent organochlorine agricultural compounds were from dieldrin, but they were all less than 4.4% of the ADI for each of the eight age-sex groups (**Appendix 2** and **Figures 2-9).** Exposure to dieldrin is solely from residues detected in courgette (1/8) and pumpkin (5/8) samples, with pumpkin contributing 85-95% of the total exposure in the current survey for each of the different age-sex groups. This result is consistent with previous NZTDSs, in which dieldrin has also been encountered in ground-grown fruiting vegetables.

Exposure to total DDT residues was almost exclusively from three of the total diet food groups: the chicken, eggs, fish and meat (CEFM) group, dairy products, and takeaway foods. This is consistent with the fat soluble nature of these persistent organochlorine agricultural compounds. Dairy products and CEFM both contributed approximately 40-45% of the total exposure for each of the age-sex groups, with takeaways about 5-10%. For all population sub-groups, estimated dietary exposure to total DDT is less than 0.6% of the ADI.

3.3.2 Trends in estimated dietary exposure to persistent organochlorine agricultural compounds

Dieldrin dietary exposures have increased since the last survey, but are all still less than 4.4% of the ADI (**Appendix 2** and **Figures 2-9**), while dietary exposures have decreased for total DDT in the 2003/04 NZTDS, and are all less than 0.7% of the ADI (**Appendix 2** and **Figures 2-9**).

DDT is usually the persistent organochlorine agricultural compound most discussed. **Figure 10** shows the estimates of daily dietary exposure for total DDT (DDT and its metabolites) determined in each of the six NZTDSs carried out to date for a 19-24 year young male, and for a 1-3 year toddler using data from the four most recent NZTDSs (1987/88, 1990/91, 1997/98 and 2003/04). The data represented in Figure 10 suggests that dietary exposure to DDT is steadily decreasing as levels of this contaminant gradually reduce in the environment. DDT levels are steadily approaching levels in foods where improved analytical methodologies will be required to detect any residues at all.

Figure 10 Estimated daily dietary exposure to total DDT for a 19-24 year young male (YM) and a 1-3 year toddler (T) in the 2003/04 NZTDS compared to previous NZTDSs

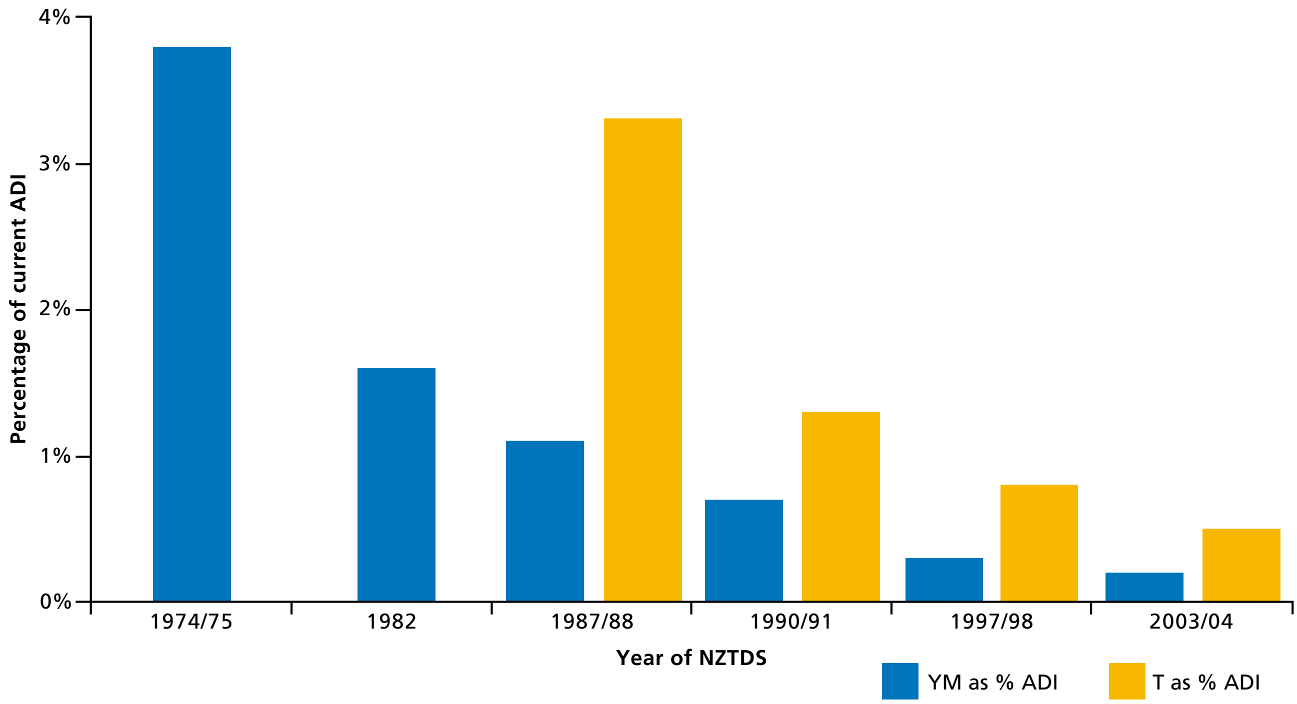
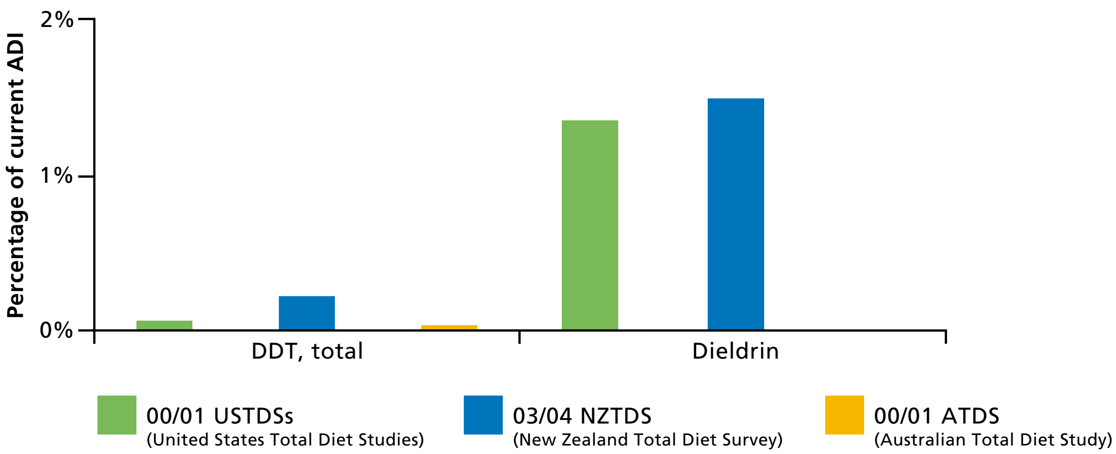


Figure 11 Comparison of estimated daily dietary exposure to persistent organochlorine agricultural compounds detected in the 2003/04 NZTDS for a 25+ year male with overseas TDSs



3.3.3 International comparisons of estimated dietary exposure to persistent organochlorine agricultural compounds

Figure 11 compares the estimated daily dietary exposure to detected persistent organochlorine agricultural compounds for a 25+ year male in the 2003/04 NZTDS with similar overseas estimates. Details of reference studies and description of age-sex groups is given in **Table 2.**

Estimated daily dietary exposures to persistent organochlorine agricultural compounds are generally comparable to overseas estimates. Total DDT estimates for all studies considered were at or less than 0.3% of the ADI, reflecting the fact that all three countries (New Zealand, Australia, and the United States) discontinued use of this agricultural compound over 25 years ago. The WHO GEMS food programme (GEMS/Food; FAO/UNEP/WHO, 1992) reported estimated total DDT exposure from 12 countries ranging from 0.004 to 69% of the ADI.

Estimated exposure to dieldrin is the highest dietary exposure for New Zealand and USTDSs, although only at 1% of the ADI. In the Australian study, dieldrin was not detected, but this is probably because their reporting limits were 3-5 times higher. Dietary exposure to DDT continues in all three countries, many years after its use has been discontinued, but at very low levels relative to the ADI.

3.4 Organophosphorus (OP) Agricultural Compound Residues

Organophosphorus agricultural compounds, such as pirimiphos-methyl and fenitrothion, are esters of phosphate-containing acids. They are mostly insecticides for the protection of crops against aphids and soft-bodied insects, and fumigants for the control of weevil during shipping and storage of grain (Jones, 1993). After mineral oils, organophosphorus agricultural compounds are the most heavily used insecticides in New Zealand (Holland and Rahman, 1999). The org anophosphorus agricultural compounds were mainly developed during the 1970s to replace the organochlorine agricultural compounds. Most organophosphorus agricultural compounds degrade readily in biological systems.

The organophosphorus agricultural compounds act on the pest's central nervous system. These compounds are cholinesterase inhibitors and, by suppressing the activity of this enzyme, allow toxic levels of the neurotransmitter acetylcholine to accumulate. As a class, the organophosphorus agricultural compounds are generally more acutely toxic than the organochlorine insecticides they replaced, but they have the great advantage that they are less persistent in the environment. In mammals, acute poisoning can result in death due to respiratory failure, while chronic exposure results in delayed neuropathy, changed behaviour and reduced reproductive efficiency (Jones, 1993).

Organophosphorus agricultural compounds have a wide range of toxicity, with ADIs ranging from 0.1 µg/kg body weight/day for prothiofos to 300 µg/kg body weight/day for malathion (IPCS, 2002). The list of ADIs for organophosphorus agricultural compounds detected in this survey is included in **Appendix 2**.

The concentrations of organophosphorus agricultural compounds in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b; 2004 a,b,c). This data is consolidated in the **Auxiliary Data** report**, Appendices 6** and **7** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of organophosphorus agricultural compounds and the associated 2003/04 NZTDS foods, sorted either by agricultural compound (**Appendix 6**) or by the 2003/04 NZTDS food (**Appendix 7**).

Residues of five organophosphorus agricultural compounds: chlorpyriphos (21 detections), chlorpyriphos-methyl (65), dimethoate (12), fenitrothion (35), and pirimiphos-methyl (138) were those most detected in foods of the 2003/04 NZTDS. Residues of these organophosphorus agricultural compounds accounted for 27% of all residues detected (271 out of a total of 997).

Chlorpyriphos was detected on fruit, and foods containing fruit (eg mixed bran cereal), and in takeaways containing cereal products (hamburgers). Dimethoate was detected exclusively on fruiting vegetables (courgettes and melons).

Chlorpyriphos-methyl, fenitrothion, and pirimiphos-methyl were detected almost exclusively on cereal products and processed foods containing cereal products, such as battered fish. Organophosphorus agricultural compounds tend to be deposited on the outer layers of the grain (on the bran layer) and removed during milling and processing (WHO, 1992c). The results observed in the current survey are consistent with this proposition, with much higher concentrations of chlorpyriphos-methyl, fenitrothion and pirimiphos methyl being observed in wheatmeal bread than white bread.

The organophosphorus agricultural compounds diazinon, dichlorvos, malathion, parathion-methyl, phosmet, prothiofos, terbufos and tetrachlorvinphos were also detected in the 2003/04 NZTDS, but only on a few samples.

3.4.1 Estimated dietary exposure to organophosphorus agricultural compounds

Estimated daily dietary exposures to organophosphorus agricultural compounds for each of the eight age-sex groups considered in the 2003/04 NZTDS are given in **Appendix 2.** Results are presented as exposures expressed as µg/kg body weight/day, and as a percentage of the relevant ADI, because ADIs differ between organophosphorus agricultural compounds.

Figures 2-9 include the estimated daily dietary exposures to the organophosphorus agricultural compounds for each of the eight age-sex groups in the 2003/04 NZTDS which were >0.4% of the ADI, namely chorpyriphos-methyl, dimethoate, fenitrothion, phorate, phosmet, pirimiphos-methyl, and terbufos.

All dietary exposures to organophosphorus agricultural compounds in the NZTDS were less than or equal to 4.1% of the ADI for all age-sex groups (**Appendix 2** and **Figures 2-9**). The highest exposure was for fenitrothion (4.1% of ADI) for the 5-6 year child, of which 70% was due to breads made from imported, not domestic, grain. This has been inferred by fingerprinting the cadmium to selenium ratio of the respective regional breads (refer to cadmium **section 4.3.2** for fuller explanation), and matching the fenitrothion to the respective regional breads. The second highest exposures were for dimethoate (3.9% of ADI) for the 6-12 month infant, of which 70-80% was contributed by courgette residues, of both domestic and imported origin.

Table 4 **Estimated daily dietary exposure to the main organophosphorus agricultural compounds for a 25+ year male in the 2003/04 NZTDS compared to previous NZTDSs**

	Estimated daily dietary exposure (as a % of current ADI)			
	1987/88 NZTDS	1990/91 NZTDS	1997/98 NZTDS	2003/04 NZTDS
Chlorpyriphos	0.15	0.33	0.06	0.04
Chlorpyriphos-methyl	0.02	0.11	1.0	0.47
Diazinon	0.04 [c]	0.005 [c]	0 [c]	0.07 [e]
Dimethoate	0 [b]	0 [b]	0.7 [b]	1.55 [c]
Fenitrothion	6.7	3	0.08	1.7
Phorate, total	NA	NA	0 [c]	0.53 [d]
Phosmet	0 [a]	0 [a]	0 [a]	0.19 [c]
Pirimiphos-methyl	1.1	0.77	0.8	0.8
Terbufos	NA	NA	NA	0.36

a LOD = 0.1 mg/kg
b LOD = 0.03
c LOD = 0.01
d LOD = 0.007
e LOD = 0.003
NA = not analysed
0% = not detected, less than LOD

3.4.2 Trends in estimated dietary exposure to organophosphorus agricultural compounds

Of the 17 agricultural compounds with dietary exposures in the 2003/04 NZTDS greater than 0.4% of the ADI (**Figures 2-9**), seven were organophosphorus compounds. The estimated dietary exposures to these compounds, in addition to chlorpyriphos and diazinon, are detailed in **Table 4**. A uniform trend is not evident.

Estimated daily dietary exposure to chlorpyriphos and chlorpyriphos-methyl has decreased since the last NZTDS, while pirimphos-methyl exposures have remained at similar levels. All are less than or equal to 0.8% of the ADI.

Fenitrothion exposures have increased in this Survey, reflecting use of imported grain, as explained in **section 3.4.1**, but are still only 1.7% of the ADI. Chlorpyriphos-methyl, pirimiphos-methyl and fenitrothion are principally found on grain products or foods containing grain products (such as sausages), as a consequence of their use as fumigants of stored grain.

Dimethoate exposures have more than doubled, due almost entirely to domestic and imported courgettes, but are still less than 1.6% of the ADI.

It should also be noted that diazinon, phorate, and phosmet were detected in the 2003/04 NZTDS because of significant improvements in analytical methodology and lowered limits of detection since the last NZTDS. Terbufos was previously not analysed.

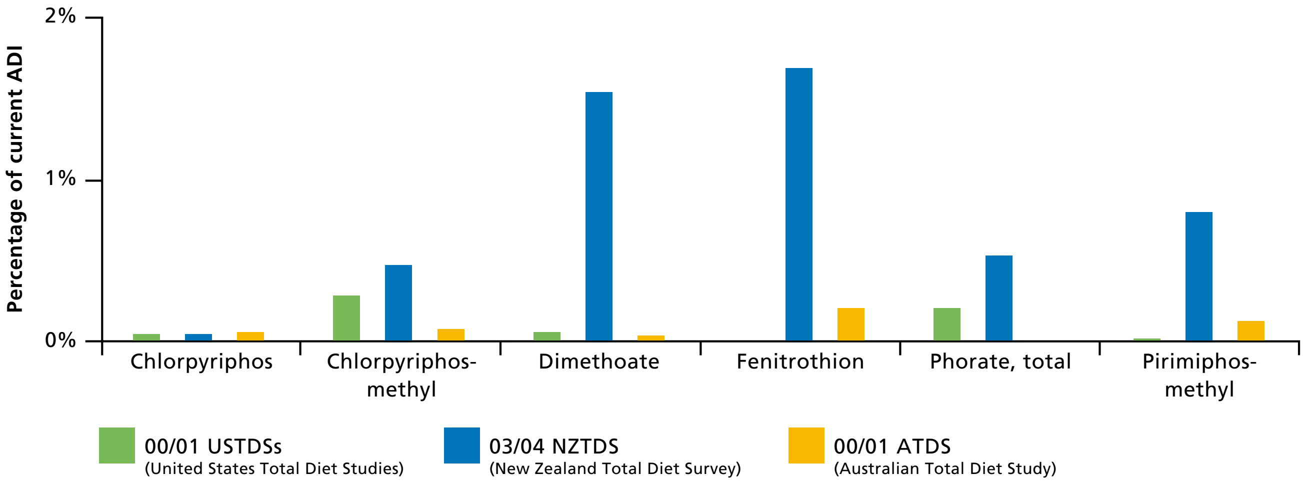
3.4.3 International comparisons of estimated dietary exposure to organophosphorus agricultural compounds

Figure 12 compares the estimated daily dietary exposure to detected organophosphorus agricultural compounds for a 25+ year male in the 2003/04 NZTDS with similar overseas estimates. Details of reference studies and description of age-sex groups is given in **Table 2**. Note that the scale in Figure 12 has been greatly expanded compared to Figures 2-9 to facilitate comparison.

The United States Total Diet Study (USTDS; Egan, 2005) generally reported low exposure estimates for the six main organophosphorus agricultural compounds also detected in the New Zealand Survey. The results from the Australian Total Diet Study (ATDS; FSANZ, 2003) were also lower. The differing pattern of estimated exposure to organophosphorus agricultural compounds between countries presumably reflects usage and climatic conditions. Importantly, all dietary exposures remain very low, being less than or equal to only 1.7% of the ADI.

The fact that the dietary exposures to fenitrothion and dimethoate in the 2003/04 NZTDS are higher than those in the 2000/01 ATDS or the 2000/01 USTDSs (**Figure 12**) does not contradict the inference that the majority of our wheat is imported, as the timing of these TDSs is quite different, as are the likely growing regions of the actual source samples analysed.

Figure 12 Comparison of estimated daily dietary exposure to organophosphorus agricultural compounds detected in the 2003/04 NZTDS for a 25+ year male with overseas TDSs



3.5 Fungicide Residues

Fungicides are necessary to control fungal diseases that when unchecked can disrupt the regular supply of varied, quality food commodities to a much greater extent than insect pests. Their main use is to stop food rotting, while their secondary benefit of use is to control mycotoxins. The mycotoxins produced by certain fungal species are typically associated with certain foods including nuts, grains and fruits. Mycotoxins have the potential to cause serious health problems in both humans and stock (WHO, 1979; WHO, 1990). Fungicides are compounds from different chemical families grouped by their prime function.

The concentrations of fungicides in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b; 2004 a,b,c). This data is consolidated in the **Auxiliary Data** report, **Appendices 6** and **7** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of fungicides and the associated 2003/04 NZTDS foods, sorted either by agricultural compound (**Appendix 6**) or by the 2003/04 NZTDS food (**Appendix 7**).

In the 2003/04 NZTDS, the nine most frequently detected fungicides were: captan (detected in 19 samples), chlorothalonil (11), dicloran (6), diphenylamine (56), DTCs (82), iprodione (60), procymidone (35), pyrimethanil (13), and vinclozolin (4).

Residues of fungicides account for 29% of all residues detected in this Survey (286 out of a total of 997). DTCs accounted for approximately 29% of the fungicide residues detected. This is consistent with the findings of a review which highlighted that DTCs are the predominant class of fungicides used in New Zealand (Holland and Rahman, 1999).

Fungicide residues were primarily detected on fruits and vegetables, or food containing fruit (muesli and yoghurt), or foods made from fruits (wine, jam) and vegetables. The range of fungicides detected in the 2003/04 NZTDS was similar to the range detected in the 1997/98 NZTDS. It is also worth noting that diphenylamine, which is a fungicide used as a post-harvest treatment on apples in New Zealand, and also on other pome fruit (pears) overseas, was found in a range of unexpected foods, including all eight samples of each of butter, cheese, and cream. It is possible that this is due to diphenylamine leaching from equipment containing elastomers or plastics, during the manufacturing process.

3.5.1 Estimated dietary exposure to fungicides

Estimated daily dietary exposures to fungicides for each of the eight age-sex groups considered in the 2003/04 NZTDS are given in **Appendix 2**. Results are presented as exposures expressed as µg/kg body weight/day, and as a percentage of the relevant ADI, because ADIs differ between fungicides.

Figures 2-9 include estimated dietary exposures to the three fungicides for each of the eight age-sex groups in the 2003/04 NZTDS which were >0.4% of the ADI, namely DTCs, iprodione and diphenylamine.

Estimated exposures for the fungicides, with the exception of DTCs, are all less than 1.2% of the relevant ADI.

A wide range of fruits and vegetables contribute to the total exposure to DTC fungicides. Major contributors include canned apricots (approximately 10% of dietary exposure for 25+ year male, and 50% for the 6-12 month infant), brassica vegetables (cabbage, broccoli/cauliflower; approximately 50% of dietary exposure for 25+ year male, and 20% for the 6-12 month infant).

The estimated exposure to DTC fungicides falls within a lower and upper bound range of 0.7-6.8% of the ADI for a 25+ year male, and similarly 1.8-18.5% of the ADI for the 6-12 month infant. This upper bound level of exposure should be viewed as a worst case estimate. DTCs consist of a group of eight agricultural compounds (ferbam, mancozeb, maneb, metiram, propineb, thiram, ziram, and zineb) which are conventionally listed as a group on the basis of the common analytical method for their determination. This involves decomposition of the parent compounds in acid and analysis of the resultant carbon disulphide. The internationally used method in the 2003/04 NZTDS does not differentiate which DTC is present.

International assessments have also suggested that these compounds should be considered as two groups on the basis of their toxicological endpoints (FAO, 1998):

- mancozeb, maneb, metiram and zineb have been assigned a group ADI of 30 µg/kg body weight/day based on their thyroid toxicity (WHO, 1994; FAO/WHO, 1996), propineb is also included in this group due to its thyroid toxicity, but has a lower ADI (7 µg/kg body weight/day; WHO, 1994)
- ferbam, thiram, and ziram have been assigned a group ADI of 3 µg/kg body weight/day, based on similar toxicities, but different to the above group because the toxicity endpoints are not associated with thyroid toxicity (FAO, 1998).

In New Zealand, DTCs from both groups are registered for use on selected fruit and vegetables. These are thiram, ziram, propineb, metiram and mancozeb.

The lower group ADI for ferbam, thiram and ziram (3 µg/kg body weight/day) has been applied in the current Survey for characterisation of the upper bound DTC exposure. If the other group of DTCs were in fact present, with their higher group ADI (30 µg/kg body weight/day), then the estimated dietary exposure would be ten fold lower, as reflected by the lower bound ranges of 0.7% of the ADI for the 25+ year male, and 1.9% of the ADI for the 6-12 month infant. The true dietary exposure will lie somewhere between the lower and upper bound estimates.

It should also be borne in mind that some commodities, such as brassicas (cabbage, broccoli, cauliflower) contain natural compounds that can produce carbon disulphide under the conditions used for DTC analysis. As carbon disulphide is the chemical species determined in the DTC analysis in the 2003/04 NZTDS (**section 2.3.1**), this can lead to an overestimation of the DTC content of these products (MAFF, 1997a). DTCs detected on brassicas account for approximately 20-50% of the estimated exposure to DTC fungicides in the 2003/04 NZTDS for the 6-12 month infant and the 25+ year male, respectively.

3.5.2 Trends in estimated dietary exposure to fungicides

Considerable effort has been put in by sectors of the fruit and vegetable industries to decrease agricultural compound usage (NZ Vegetable and Potato Growers' Federation, 1997). **Table 5** shows the estimates of daily dietary exposure for the 25+ year male age-sex group from the 1987/88, 1990/91, 1997/98 and 2003/04 NZTDSs to the seven most commonly observed fungicides.

It is noted that exposures to five of these fungicides (chorothalonil, dicloran, diphenylamine, iprodione, vinclozolin) have decreased since the last NZTDS.

The estimated exposure to DTC fungicides seems to be at a comparable level to 1990/91 and lower than in 1997/98. It should be noted that the limit of detection for DTCs has decreased significantly from 0.50 mg/kg carbon disulphide in the 1990/91 NZTDS to 0.01 mg/kg carbon disulphide in the 1997/98 and 2003/04 NZTDSs, resulting in an improved level of confidence in the corresponding exposure estimate.

3.5.3 International comparisons of estimated dietary exposure to fungicides

Figure 13 compares the estimated daily dietary exposure to detected fungicides for a 25+ year male in the 2003/04 NZTDS with similar overseas estimates. Details of reference studies and description of age-sex groups is given in **Table 2.**

Exposure estimates for chlorothalonil and procymidone were not reported for the USTDS. DTCs were not included in this comparison, as neither of the comparison studies included estimates of DTC exposure.

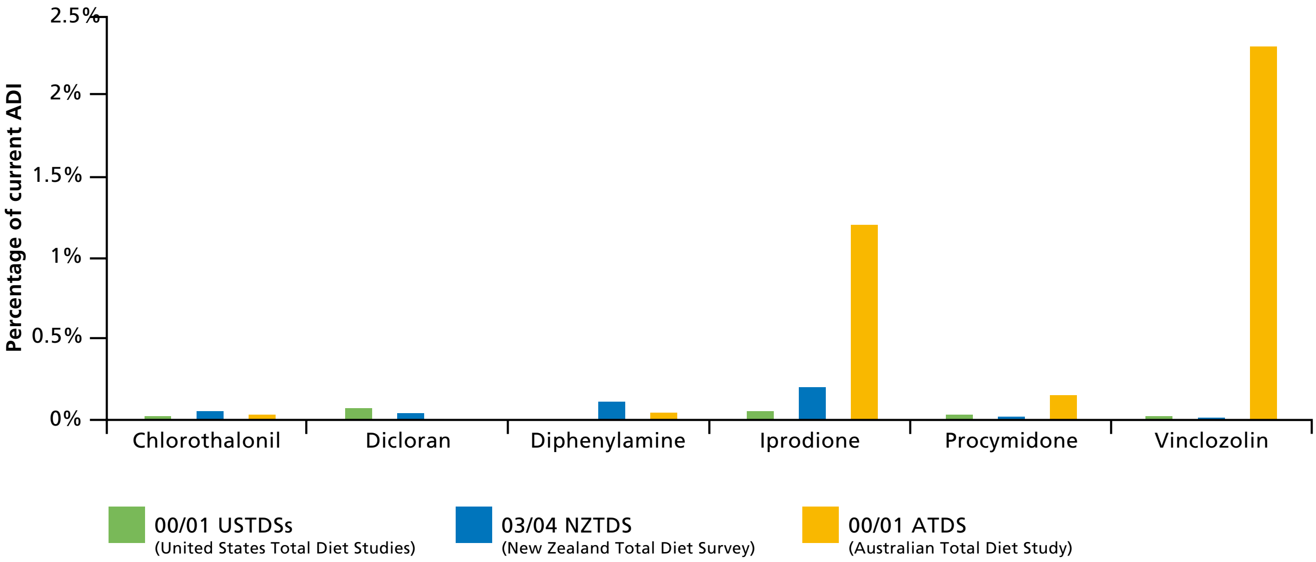
Estimated daily dietary exposure to fungicides in New Zealand generally compares favourably to estimates from other studies considered. Note that the scale in **Figure 13** has been greatly expanded. Interestingly, dietary exposures to fungicides appear to be higher in Australia than New Zealand or the United States, whereas for organophosphorus agricultural compounds, New Zealand was the highest. Whatever the country, all dietary exposures to fungicides are still at a low level relative to the ADI.

Table 5 Estimated daily dietary exposure to fungicides for a 25+ year male in the 2003/04 NZTDS compared to previous NZTDSs

	Estimated daily dietary exposure (as a % of current ADI)			
	1987/88 NZTDS	1990/91 NZTDS	1997/98 NZTDS	2003/04 NZTDS
Chlorothalonil	0.12	0.010	0.010	0.005
Dicloran	NA	NA	0.11	0.04
Diphenylamine	0.4	0	0.9	0.1
Dithiocarbamates	NA	0.8 - 7.8 [a]	1 - 10 [a]	0.7 - 6.8 [a]
Iprodione	0.15	0.31	0.8	0.2
Procymidone	0.2	0.05	0.01	0.02
Vinclozolin	1.4	1.1	0.030	0.001

*a Lower and upper bound exposure estimates, relative to ADI used (**see 3.5.1** for explanation)*
NA = Not analysed

Figure 13 Comparison of estimated daily dietary exposure to fungicides for a 25+ year male in the 2003/04 NZTDS with overseas TDSs



3.6 'Other' Agricultural Compound Residues

As the name suggests the category of 'other' agricultural compounds contains an assortment of generally unrelated agricultural compounds, including herbicides, insecticides, post-harvest sprouting inhibitors and synergists (compounds which increase the effectiveness of other agricultural compounds, with which they are applied in conjunction).

The concentrations of 'other' agricultural compounds in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b; 2004 a,b,c). This data is consolidated in the **Auxiliary Data** report**, Appendices 6** and **7** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of 'other' agricultural compounds, and the associated 2003/04 NZTDS foods, sorted either by agricultural compound (**Appendix 6**) or by the 2003/04 NZTDS food (**Appendix 7**).

Residues of 'other' agricultural compounds detected in the 2003/04 NZTDS were carbaryl (21), chlorpropham (4), cypermethrin (5), dicofol (7), total endosulfan (35), ethoxyquin (25), indoxacarb (8), permethrin (18), piperonyl butoxide (14), propargite (11) and propham (19). Residues of these 'other agricultural compounds' accounted for 17% of all residues detected (167 out of a total of 997).

Carbaryl and indoxacarb are carbamate insecticides, and were detected on a range of fruit and vegetables. Chlorpropham and propham are sprout inhibitors, consistent with finding them mainly on potato-related products. Piperonyl butoxide is a synergist usually used in conjunction with pyrethroid agricultural compounds, such as permethrin and cypermethrin (Tomlin, 1994). Dicofol and endosulfan are miticides (to control mites) and insecticides, respectively, and were also found on a range of fruit and vegetables.

Ethoxyquin has been used over the years as a feed additive in animal food, an anti-oxidant, a fungicide, a post harvest dip, and a plant growth regulator. Maximum Residue Limits (MRLs) have previously been set in Canada and the USA for ethoxyquin in meat, poultry livers and eggs. Ethoxyquin was found primarily in poultry and meat products in the 2003/04 NZTDS, primarily as a result of feed use.

Propargite, a contact miticide for fruiting crops, was detected primarily in raisins/sultanas.

No residues of the acid herbicides (2,4-D, 2,4-DB, 2,4,5-T, bentazone, bromoxynil, chlorsuphuron, clopyralid, cymoxanil, dicamba, dichlorprop, MCPA, MCPB, mecopropr-P, metamitron, metsufuron, picloram, triasulfuron, and triclopyr), which were separately screened for in selected NZTDS foods, were detected in the 2003/04 NZTDS.

Table 6 Estimated daily dietary exposure to 'other' agricultural compounds for a 25+ year male in the 2003/04 NZTDS compared to previous NZTDSs

	Estimated daily dietary exposure (μg/kg body weight/day)			
	1987/88 NZTDS	1990/91 NZTDS	1997/98 NZTDS	2003/04 NZTDS
Bromopropylate	0 [a]	0.0020	0.0010	0.0001
Dicofol	0 [a]	0 [a]	0.0060	0.0021
Endosulfan (total)	0 [a]	0.0304	0.0010	0.0375
Permethrin	0 [a]	0.007	0	0.006
Piperonyl butoxide	NA	0.006	0.078	0.010
Propham	1.2	0.80	0.62	0.24

0 Not detected in any food analysed in respective NZTDS
a Limit of detection higher in these NZTDSs
NA = Not analysed

3.6.1 Estimated dietary exposure to 'other' agricultural compounds

Estimated daily dietary exposures to 'other' agricultural compounds for each of the eight age-sex groups considered in the 2003/04 NZTDS are included in **Appendix 2**. Results are presented as exposures expressed as μg/kg body weight/day, and as a percentage of the relevant ADI, because ADIs differ between agricultural compounds.

The highest estimated daily dietary exposures to the 'other' agricultural compounds for each age-sex group in the 2003/04 NZTDS were for carbaryl (4.2% of the ADI), dicofol (0.8%), ethoxyquin (0.9%), endosulfan, total (0.7%) and propargite (0.4%) (**Figures 2-9** and **Appendix 2**).

3.6.2 Trends in estimated dietary exposure to 'other' agricultural compounds

Table 6 compares the exposure estimates derived for four other agricultural compounds in the current survey with those derived in the 1987/88, 1990/91 and 1997/98 NZTDSs. It should be noted that the scale in this table is expressed in terms of μg/kg body weight/day, rather than as a percentage of the ADI. This is due to the fact that no ADI has been established for the sprout inhibitor, propham. Carbaryl, ethoxyquin and propargite are not included in the table as they were not analysed in previous NZTDSs, so comparative data is not available.

Estimates of exposure to brompropylate and propham have decreased across the last four NZTDSs.

Permethrin exposures are very low and comparable to 1990/91 levels, despite a ten fold lower limit of detection in 2003/04.

Dicofol dietary exposures have decreased since the last NZTDS, and are all still less than 0.8% of the ADI (**Appendix 2** and **Figures 2-9**).

Dietary exposures have increased for total endosulfan in the 2003/04 NZTDS, and are all less than 0.7% of the ADI (**Appendix 2** and **Figures 2-9**).

3.6.3 International comparisons of estimated dietary exposure to 'other' agricultural compounds

Dietary exposures to 'other' agricultural compounds in New Zealand are generally low in comparison with Australia and the USA, with the exception of carbaryl and endosulfan (**Figure 14**). In the Australian study, chlorpropham was not screened for, and dicofol was not detected, but this is probably because their detection limits were five times higher. Dietary exposures in all three countries are at very low levels relative to the ADI.

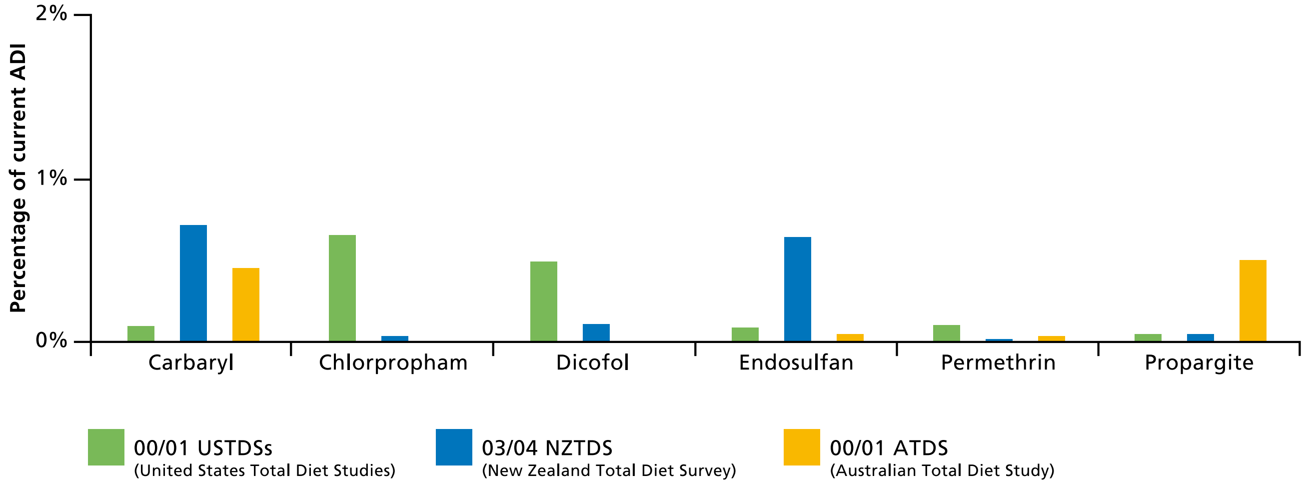
3.7 Exposure Estimates of Agricultural Compound Residues Found

The agricultural compound residues found in the 2003/04 NZTDS result in dietary exposure estimates that are all well below the ADI.

The highest estimated dietary exposure was for the DTC fungicides, which were between lower and upper bounds of 0.7% and 6.8% of the ADI for adults, and 1.9% and 18.5% of the ADI for infants, respectively. The upper bound is considered to be an overestimate because of assumptions about ADIs of DTCs contributing to the exposure estimates, and also probable interference from naturally occurring constituents of brassicas.

All other estimated dietary exposures to agricultural compound residues from the eight age-sex group simulated typical diets were less than 5% of the level of their ADI, with 90% of dietary exposures in fact less than 0.1% of the ADI.

Figure 14 Comparison of estimated daily dietary exposure to 'other' agricultural compounds for a 25+ year male in the 2003/04 NZTDS with overseas TDSs



4 CONTAMINANT ELEMENTS: RESULTS AND DISCUSSION

4.1 Introduction to Contaminant Elements

The four contaminant elements investigated in the 2003/04 NZTDS were arsenic, cadmium, lead and mercury. These are priority contaminants of the World Health Organization (WHO) Global Environmental Monitoring System (GEMS)/Food programme and their inclusion maintains continuity with previous NZTDSs. Mercury is not essential for humans and the essentiality of arsenic, cadmium, and lead has yet to be demonstrated. All of these contaminants are toxic when ingested at sufficient doses and as such they pose a greater risk to humans than any concern about a lack in the diet as nutrients (UK DoH, 1991). Contaminant elements are naturally occurring and ubiquitous in our environment, so the contaminant content of foods can vary significantly over time.

4.2 Contaminant Element Results

4.2.1 Concentration data and estimated weekly dietary exposures of the 2003/04 NZTDS

Methodology for determining mean concentration data and dietary exposure estimates has been explained previously in **Section 2.4.2** and **Section 2.5**, respectively.

Details of the concentrations of contaminant elements in the 121 individual foods assessed in the 2003/04 NZTDS are contained in the **Auxiliary Data** report**, Appendix 8**, (Vannoort and Thomson, 2005).

Table 7 gives the resultant estimated weekly dietary exposures of contaminant elements for the 2003/04 NZTDS. These exposures are also shown as a percentage of the international PTWI.

4.2.2 Comparison of 2003/04 NZTDS with previous NZTDSs

The 19-24 year young male and 6-12 month infant groups have been used as examples throughout the discussion because the high energy intake for young males and low body weight for infants increases their potential risk from exposure to contaminant elements. When appropriate, the 25+ year male, 11-14 year girl or 1-3 year toddler have also been discussed.

Weekly dietary exposures for young males have been compared with the results from previous New Zealand TDSs on a µg/kg bw/week basis. In the 1982 NZTDS, the energy content of the young male diet was set at 16.7 MJ/day, corresponding to an active young male consumer. In the 1987/88 and 1990/91 NZTDSs, the median energy intake of 13.8 MJ/day was chosen for a young male, corresponding to a moderately active (50th percentile) young male. In the 1997/98 NZTDS, the median energy content for a young male was based on Life in New Zealand (LINZ, 1992) data and revised to 11.5 MJ/day. In the 2003/04 NZTDS, the median energy content for a young male was 13.8 MJ/day, and was based on the 1997 National Nutrition Survey (NNS; Russell et al, 1999). In order to compare the results between the NZTDSs, the weekly dietary exposure from the 1982 NZTDS for an active young male has been re-calculated on the basis of the same median energy intake as that for a young male in the 1987/88 NZTDS. Comparisons with the 1982 NZTDS can still only be indicative because of differences in the survey and diet protocols.

Table 7 Summary of estimated weekly dietary exposures (µg/kg bw/week) to contaminant elements in the 2003/04 NZTDS

Elements	International Standard (µg/kg bw/wk)	25+ yr Male	25+ yr Female	19-24 yr Young Male	11-14 yr Boy	11-14 yr Girl	5-6 yr Child	1-3 yr Toddler	6-12 month Infant
Arsenic (total)	350 [a], (15) [b]	9.7 - 9.9 - 10.1 [c]	7.4 - 7.6 - 7.8	8.9 - 9.1 - 9.3	8.9 - 9.2 - 9.4	4.8 - 5.0 - 5.2	9.8 - 10.2 - 10.6	11.2- 11.8 -12.4	10.2 - 10.8 - 11.4
% of PTWI (total As) [a]		2.8%	2.2%	2.6%	2.6%	1.4%	2.9%	3.4%	3.1%
% of PTWI (inorganic As) [b]		10%	8.8%	10%	11%	6.8%	14%	15%	17%
Cadmium (diet incl'g oysters)	7 [d]	2.0 - 2.0 - 2.1	1.5 - 1.5 - 1.5	1.8 - 1.8 - 1.8	1.7 - 1.7 - 1.7	1.4 - 1.4 - 1.4	2.5 - 2.6 - 2.6	2.5 - 2.6 - 2.6	2.1 - 2.1 - 2.2
% of PTWI		29%	22%	26%	25%	20%	37%	37%	30%
Cadmium (diet excl'g oysters)	7 [d]	1.1 - 1.2 - 1.2	0.9 - 0.9 - 1.0	1.2 - 1.3 - 1.3	1.7 - 1.7 - 1.7	1.4 - 1.4 - 1.4	2.5 - 2.6 - 2.6	2.5 - 2.6 - 2.6	2.1 - 2.1 - 2.2
% of PTWI		16%	13%	18%	25%	20%	37%	37%	30%
Lead (& normal babyfood, cornflour)	25 [e]	0.7 - 0.9 - 1.1	0.6 - 0.8 - 0.9	0.8 - 1.0 - 1.1	0.9 - 1.0 - 1.2	0.7 - 0.9 - 1.0	1.4 - 1.7 - 2.0	1.7 - 2.1 - 2.6	1.9 - 2.4 – 2.8
% of PTWI		3.6%	3.1%	3.8%	4.2%	3.5%	6.9%	8.6%	9.5%
Lead *		0.7 - 0.9 - 1.1 *	0.6 - 0.8 - 0.9 *	0.8 - 1.0 - 1.1 *	0.9 - 1.0 - 1.2 *	0.7 - 0.9 - 1.0 *	1.4 - 1.7 - 2.0 *	1.7 - 2.1 - 2.6 *	2.5 - 2.9 - 3.4 *
% of PTWI *		3.6% *	3.1% *	3.8% *	4.2% *	3.5% *	6.9% *	8.6% *	11.7% *
Mercury (total)	5 [f], (1.6) [g]	0.57 - 0.74 - 0.90	0.45 - 0.60 - 0.74	0.5 - 0.74 - 0.90	0.60 - 0.74 - 0.88	0.34 - 0.46 - 0.58	0.80 - 1.1 - 1.3	0.93 - 1.3 - 1.6	0.86 - 1.3 - 1.7
% of PTWI (total)		15%	12%	15%	15%	9%	21%	25%	26%
% of PTWI (methylmercury)		46%	38%	46%	46%	29%	69	81%	81%

a PTWI is derived from maximum allowable daily body load for total arsenic (WHO, 1967)
b PTWI is established for inorganic arsenic (15 µg/kg bw/week) (WHO, 1989b), not total arsenic
c Lower, mid and upper bound estimates based on assigning zero, LOD/2 and LOD, respectively, to non-detects
d WHO, 2004
e WHO, 2000
f PTWI is for total mercury (WHO, 1978b)
g PTWI for methylmercury (WHO, 2004)
**** Includes anomalous result due to single lead contamination event (see section 4.3.3). Impact on dietary exposure only evident in infant diet, as contaminated cornflour a minimal component of other diets***

Table 8 Overseas TDSs used for comparison with 2003/04 NZTDS

Country	Time period	Person	Body weight (kg)	Age (years)	Reference
NZTDS [a,b,c]	2003/04	Male	82	25+	this report
Australia [a,c]	2000/01	Adult male	82	25-34	FSANZ, 2003
USA [a,c]	2000/01	Male	80	25-30	Egan, 2005
UK [a,c]	2000	Adult	60	NS	UK FSA, 2004
Korea [d]	2000	Average person	NS	NS	Kwon et al, 2001
China [a]	2000	Male	NS	20-50	Gao, 2004
Czech Republic [e]	2002	Male	70	18+	Ruprich, 2003
Basque Country [c]	1992-95	Adult	68	25-60	Jalon et al, 1997
France [b,e]	2000/01	Adult	65	15+	Leblanc et al, 2005

a Using zero values for 'not detected' data
b Using half limit detection for 'not detected' data
NS Not Specified
c Using limit of detection for 'not detected' data
d Protocol for assigning 'not detected' data not known
e Using half limit quantitation for 'not quantified' data

4.2.3 Comparison of 2003/04 NZTDS with overseas TDSs for contaminants

The weekly dietary exposures for 25+ year males in the 2003/04 NZTDS have been compared to adult males in overseas TDSs, and these studies are detailed in **Table 8.**

Such comparisons need due caution, and the reasons for this have been detailed previously (**section 3.1.3**). It is also important to understand how 'not detected' results are dealt with. The protocol for this in the 2003/04 NZTDS has been explained in **Section 2.4.2**. **Table 8** includes footnotes which summarise this protocol in the overseas TDSs used for comparison.

4.3 Contaminant Elements Discussion

4.3.1 Arsenic (As)

Arsenic is a common element, widespread in nature in both living systems and geologically. It is present in all soils, but the geology of a particular soil determines the quantity present. Apart from the geological origin, soil content may be affected by the past use of arsenic-containing agricultural compounds, proximity to smelters or coal-fired power plants, or erosion caused by intensive land use. In addition, water often contains arsenic and extremely high levels may be found in groundwater from areas with geothermal activity and with arsenic rich rocks (Anke, 1986).

Arsenic occurs in food in organic and inorganic forms. Most foods contain some arsenic, but fish and seafoods can accumulate arsenic from their environment (WHO, 1981). The arsenic content of plants is usually determined by the arsenic content of the soil, water, air, fertilisers and other chemicals.

Inorganic arsenic compounds are more toxic to humans than the organic forms, in contrast to lead and mercury, for which the organic forms are more toxic. Inorganic arsenic can cause a range of acute and chronic health effects. These include skin effects (thickening and pigmentation changes), heart problems, peripheral vascular disorders, and both central and peripheral neurological damage. Prolonged exposure to high levels of trivalent or pentavalent arsenic has also been linked to skin tumours of low malignancy. In contrast, organic forms of arsenic, like arsenobetaine, are generally of low toxicity (WHO, 1981; WHO 1989c; Reilly, 1991).

The total amount of arsenic taken daily by humans is influenced by the amount of seafood in the diet. Most of the arsenic is present in marine fish and shellfish as organic arsenic compounds, mainly arsenobetaine (Larsen et al, 1993). The bulk of this arsenic is excreted unaltered from humans within several days (Tam et al, 1982).

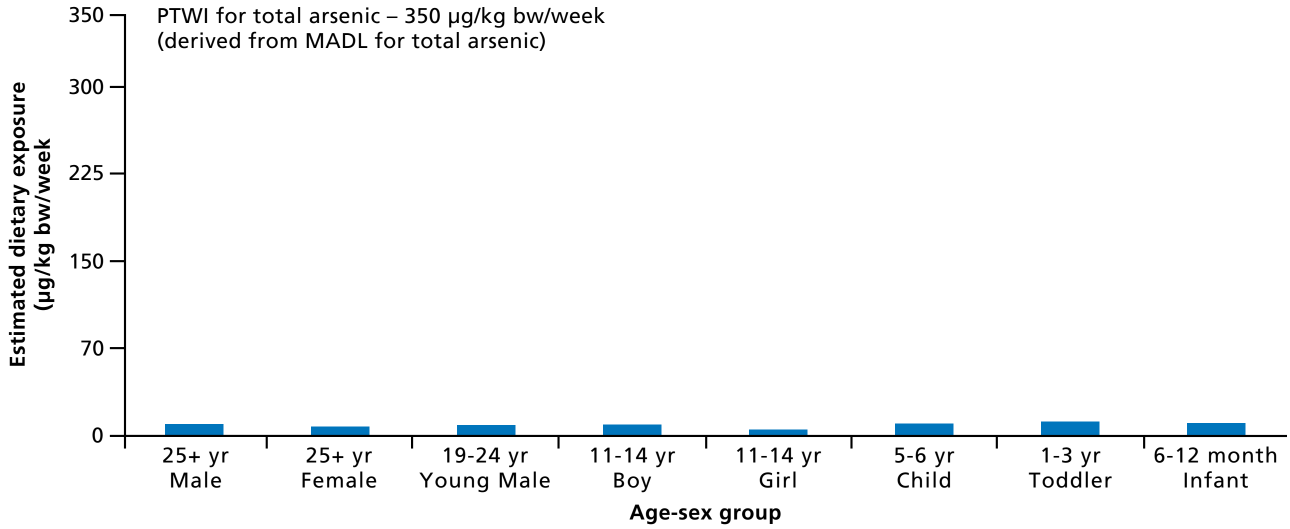
In the 2003/04 NZTDS, total arsenic was analysed, not inorganic arsenic. The concentrations of total arsenic in individual foods of the 2003/04 NZTDS were previously presented (Vannoort, 2003b, 2004 a,b,c). This data has been consolidated in the **Auxiliary Data** report**, Appendix 8.1** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of total arsenic for the 2003/04 NZTDS foods.

The estimated weekly dietary exposures to total arsenic for the eight age-sex groups of the 2003/04 NZTDS are given in **Table 7**. Exposures are expressed as µg/kg bw/week.

Internationally for TDSs, arsenic is usually analysed as total arsenic (as in the 2003/04 NZTDS), yet the toxic form is inorganic arsenic. Although a Maximum Allowable Daily Body Load (MADL) of total arsenic of 50 µg/kg bw/day was set in 1967 by the WHO, more recently the Joint FAO/WHO Expert Committee on Food Additives (JECFA) has set a PTWI of 15 µg/kg bw/week for inorganic arsenic (WHO, 1989b).

The estimated weekly dietary exposures to total arsenic for the eight age-sex groups of the 2003/04 NZTDS are presented in **Figure 15**. Results show that the exposures are all less than 12 µg/kg bw/week.

Figure 15 Estimated weekly dietary exposure to total arsenic for the eight age-sex groups of the 2003/04 NZTDS



The seafoods – fresh, battered and canned fish, mussels and oysters – contributed 90% of dietary total arsenic exposure for the 19-24 year young male. With oysters and mussels replaced by fish fingers in the 1-3 year child simulated typical diet (see **Auxiliary Data** report, **Appendix 2**; Vannoort and Thomson, 2005), the four seafood products contributed 85% of dietary exposure to total arsenic.

It is preferable to relate dietary exposures to the most toxicologically relevant standard. However, converting total arsenic dietary exposure to inorganic arsenic dietary exposure does involve making some assumptions. Previous studies have suggested that 0.4-5.3%, 0.5-3.5% and 2-7% of total arsenic in fish/seafood is present as inorganic arsenic (Brooke and Evans, 1981; Storelli and Marcotrigiano, 2000; Munoz et al, 2000, respectively). Schoof et al (1999) have reported a survey of total and inorganic arsenic in 40 different foods. Of the total arsenic, inorganic arsenic ranged from <1%-100%: marine fish (<1%), beef, chicken (1%), tomatoes (10%), rice (24%), potatoes (28%), apples and grapes (38%), carrots (53%), spinach and peas (100%). The US FDA has assumed that 10% of total arsenic in fish/seafood is inorganic, and that the arsenic in all other foods is 100% inorganic (Tao and Bolger, 1999). Using the US FDA assumptions, which it acknowledges are conservative, the 2003/04 NZTDS dietary exposures estimated for inorganic arsenic ranged from 6.8% of the PTWI for inorganic arsenic for the 11-14 year girl, to 17% for the 6-12 month infant (**Table 7**).

Table 9 shows the 2003/04 NZTDS weekly dietary exposures to total arsenic for a young male compared to previous NZTDSs. As is the case with most overseas TDSs, there is no clear trend in total dietary arsenic exposure over time. Dietary exposure to arsenic in NZTDSs did, however, seem to vary with the arsenic levels found in fish/seafood in each survey, and their associated consumption levels. The concentrations of total arsenic in seafood products of the 2003/04 NZTDS were consistent with previous NZTDSs (Vannoort et al, 1995b, 2000) and overseas findings (Anke, 1986; National Food Agency of Denmark, 1990; Dabeka et al, 1993).

Table 9 Estimated weekly dietary exposure (µg/kg bw/week) to total arsenic for a 19-24 year young male in the 2003/04 NZTDS compared to previous NZTDSs

Element	1982[a] NZTDS	1987/88[b] NZTDS	1990/91[c] NZTDS	1997/98[d] NZTDS	2003/04 NZTDS
Arsenic (total)	25	6.7	15	8.7	9.1

a Pickston et al, 1985
b ESR/MoH, 1994
c Vannoort et al, 1995b
d Vannoort et al, 2000

Table 10 Estimated weekly exposure (µg/kg bw/week) to total arsenic for a 25+ year male in the 2003/04 NZTDS compared to overseas TDSs

Element	PTWI µg/kg-bw/wk	NZTDS 2003/04 Male 25+ yr	Australia Male 25-34 yr	USA Male 25-30 yr	UK Male adult	France Adult 15+ yr	Korea Av. person	Czech Male 18+ yr	Basque Adult 25-60 yr
Arsenic total)	350 *	9.9 [2]	5.0 [a2]	1.8 [b1]	11 [c2]	4.3 [d2,5]	21 [e4]	2.5 [f5]	31 [g3]

a 2000/01 data (FSANZ, 2003)
b 2000/01 data (Egan, 2005)
c 2000 data (UK FSA, 2004)
d 2000/01 data (Leblanc et al, 2005)
** It must be noted that PTWI of 15 µg/kg bw/week is for inorganic arsenic, not total arsenic (WHO, 1989b)*
e 2000 data (Kwon et al, 2001)
f 2002 data (Ruprich, 2003)
g 1992-95 data (Jalon et al, 1997)
1 Using zero values for 'not detected' data
2 Using half limit detection for 'not detected' data
3 Using limit of detection for 'not detected' data
4 Protocol for 'not detected' data not known
5 Using half limit quantitation for 'not quantified' data

Table 10 compares the 2003/04 NZTDS weekly dietary exposure to total arsenic for the 25+ year male with those of Australia, the USA, the UK, France, the Republic of Korea, the Czech Republic, and the Basque Country for a similar age-sex group. The 2003/04 NZTDS estimated weekly dietary exposure to total arsenic (9.1 µg/kg bw/week) is of a similar magnitude to the weekly dietary exposures of the UK (11, UK FSA, 2004). The dietary exposures to total arsenic for Australia (5.0, FSANZ, 2003), and France (4.3, Leblanc et al, 2005) are similar to each other and lower than New Zealand's. Dietary exposure in the USA (1.8, Egan, 2005) is low because 'not detected' foods are assigned to zero, and this approach is known to underestimate exposure. The Czech weekly dietary exposure to total arsenic (2.5, Ruprich, 2003) reflects the low consumption of seafood, freshwater fish and related products (67 g/average person/week; Ruprich, 1999) compared to New Zealand (250 g/young male/week; Brinsdon, 2004). The highest total arsenic weekly dietary exposures have been reported by the Basque Country (31, Jalon et al, 1997), which correlates with their very high consumption of fish/seafood (623 g/Basque adult/week; Jalon et al, 1997) and the Republic of Korea (21, Kwon et al, 2001), who regularly consume seaweed in their diet.

4.3.2 Cadmium (Cd)

The metal cadmium occurs naturally at low levels in the environment. As a consequence of human activity, substantial amounts of cadmium are continuously added to the soil, water and air. Industrial processes, such as mining and smelting for non-ferrous metals, or electroplating, are often linked to incidents of cadmium pollution. Agricultural activity, particularly the addition of fertilisers (both natural and manufactured), may also increase the levels of cadmium in agricultural areas. Volcanic activity is also a major source of cadmium released into the environment. This is of specific relevance to New Zealand because of its extinct, dormant and active volcanoes and geothermal areas.

The content of cadmium in plants tends to reflect the levels in the soil, particularly if the soil is acidic. Shellfish and the kidney of stock animals can concentrate cadmium from their local environment (Kostial, 1986; WHO, 1992a; WHO, 1992b).

Exposure to cadmium from man-made sources is a relatively recent phenomenon. It has occurred over the last two centuries in humans, arising from both industrial activity and cigarette smoking. Inhaled cadmium is absorbed much more efficiently than ingested cadmium (Kostial, 1986).

Cadmium can have serious effects on health. The renal cortex appears to be the most sensitive target tissue in humans, resulting in chronic kidney failure. Osteomalacia (softening of the bones) is also seen. Toxicity is in part due to cadmium's extremely long half life in mammalian systems.

In 2003, JECFA confirmed a previous evaluation, setting a PTWI of 7 µg/kg bw/week for adults (WHO, 2004). The PTWI takes into account the finding that infants and young children bioaccumulate cadmium faster than older age groups and gives adequate margins for 50 years of exposure of the renal cortex (WHO, 1989b).

The concentrations of cadmium in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b, 2004 a,b,c). This data has been consolidated in the Auxiliary Data report, Appendix 8.2 (Vannoort and Thomson), detailing the minimum, maximum and arithmetic mean concentrations of cadmium for the 2003/04 NZTDS foods.

The presence of cadmium in the majority of these foods probably reflects our geology, and may also reflect New Zealand's historic use of phosphate rock from Nauru for production of superphosphate fertilisers. This rock was significantly contaminated with cadmium compared to some other sources of phosphate rock (eg southern, eastern USA or Russia), but it was relatively cheaper (Reilly, 1991). Since January 1998, the New Zealand fertiliser industry has achieved a voluntary industry standard of 280 mg cadmium/kg phosphate for phosphatic fertilisers (Furness, 1999).

The levels of cadmium in the 2003/04 NZTDS foods were generally consistent with internationally documented levels (WHO, 1992a; Jensen, 1992). A few key 2003/04 NZTDS mean cadmium food levels are listed in Table 11 with comparative data from previous NZTDSs and overseas. In 1997/98, it appeared that the mean concentration of cadmium in food staples, such as bread, milk and potatoes, had increased since 1990/91. However, sample numbers for each individual food in the 1997/98 NZTDS were limited (2-10), so a more in-depth follow-up survey was undertaken in 2000, with 30 samples of seven key foods, including white bread, wheatmeal bread, whole milk, and potatoes (Vannoort, 2001).

Table 11 Mean cadmium concentrations (mg/kg) in key foods in the 2003/04 NZTDS compared to previous NZTDSs and overseas

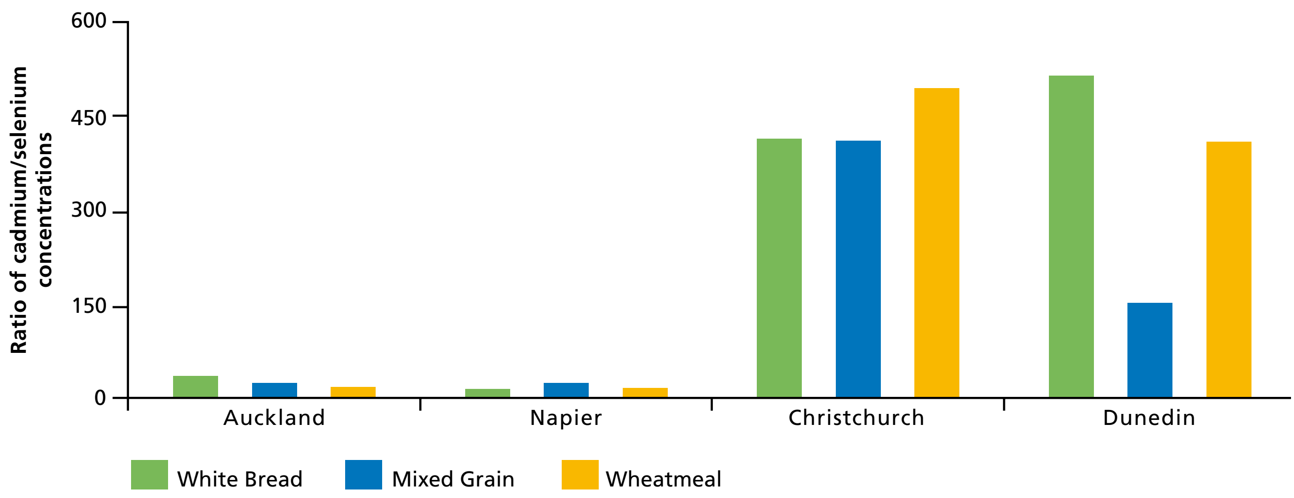
Food	1987/88 NZTDS	1990/91 NZTDS	1997/98 NZTDS	2000 NZ [a]	2003/04 NZTDS [b]	Overseas Concentration	Overseas reference
Bread, white	0.013	0.012	0.018	0.018	0.015	0.008	Hardy, 1998
Bread, wheatmeal	0.013	0.017	0.025	0.022	0.018	0.013	Hardy, 1998
Milk, whole	<0.005	0.00033	0.0015	0.0007	0.0002	0.0004	Dabeka et al, 1992
Liver lambs fry	0.145	0.255	0.113	NA	0.101	0.032	MAFF, 1998a
Oysters, raw	3.48	0.39	4.48	NA	2.92	0.35	FAO/UNEP/WHO, 1988
Potatoes, peeled	0.020	0.009	0.028	0.016	0.023	0.015	MAFF, 1997c

a Vannoort, 2001; number of samples analysed (n) = 30 per food

b n = 8 per food

Behind these mean data, a fuller investigation of the quarterly concentration data for white and wholemeal breads (Vannoort 2003b, 2004 a,b,c) demonstrates that cadmium/selenium ratios can be used to fingerprint whether local or imported grain has been used in the making of breads in the four sampling regions of the 2003/04 NZTDS. This has also been linked to fenitrothion residues, which are not registered for use on grains in New Zealand (NZFSA, 2005), but are used in Australia and overseas (**Section 3.4.1**)

Figure 16 Ratio of cadmium : selenium concentrations for different regions and bread types in the 2003/04 NZTDS



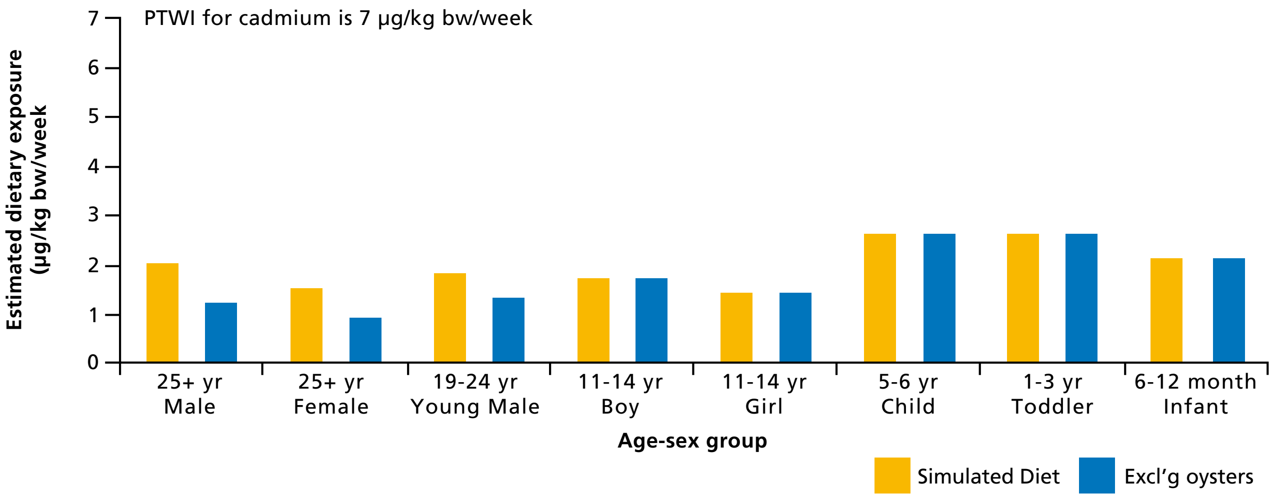
The main grain growing region in New Zealand is the South Island, so breads sampled in Christchurch and Dunedin will normally use locally grown, readily available grain which is known to have significantly higher cadmium and lower selenium contents than imported grains.

Conversely, with the deregulation of the wheat industry, North Island bread manufacturers predominantly use imported grains, which have lower cadmium and higher selenium content than New Zealand grown grains. This is illustrated in **Figure 16**, with the cadmium to selenium ratios for white, wheatmeal and mixed grain breads manufactured in Auckland and Napier (North Island) using imported grain significantly lower than those made in Christchurch and Dunedin (South Island) using New Zealand grown grain. These differences mean that the dietary exposure to cadmium from bread consumption alone for a 25+ year male in the North Island (0.12 µg/kg bw/week) is approximately half that of those in the South Island (0.26 µg/kg bw/week), and the same ratio applies for the other age-sex groups. But breads contribute only 9-17% of dietary cadmium for these age-sex groups (see **Figure 18**).

The estimated weekly dietary exposures to cadmium for the eight age-sex groups of the 2003/04 NZTDS have been summarised previously in **Table 7**. Exposures are expressed as µg/kg bw/week, and as a percentage of the PTWI.

The estimated weekly dietary exposures to cadmium for the eight age-sex groups of the 2003/04 NZTDS are also presented in **Figure 17**. Inclusion of oysters in the simulated typical diets represents a worst case scenario because for most sections of the community, oysters are likely to be a very minor or seasonal component of the diet, if consumed at all. The type of oyster can also influence the cadmium exposure, with dredge oysters being higher in cadmium than Pacific oysters.

Figure 17 Estimated weekly dietary exposure to cadmium for the eight age-sex groups of the 2003/04 NZTDS, for simulated diet or simulated diet excluding oysters



For this reason, dietary cadmium exposure has also been considered with the exclusion of oysters from the simulated typical diets. **Figure 17** shows that estimated weekly dietary exposures for the eight age-sex groups are all well below the PTWI for cadmium, and that these exposures are significantly reduced for a 25+ year male and female and 19-24 year young male when oysters are excluded from the diet. Oysters are not included in the simulated typical diets for 11-14 year boy/girl, 5-6 year child, 1-3 year toddler, and 6-12 month infant (**Auxiliary Data** report**, Appendix 2**; Vannoort and Thomson, 2005).

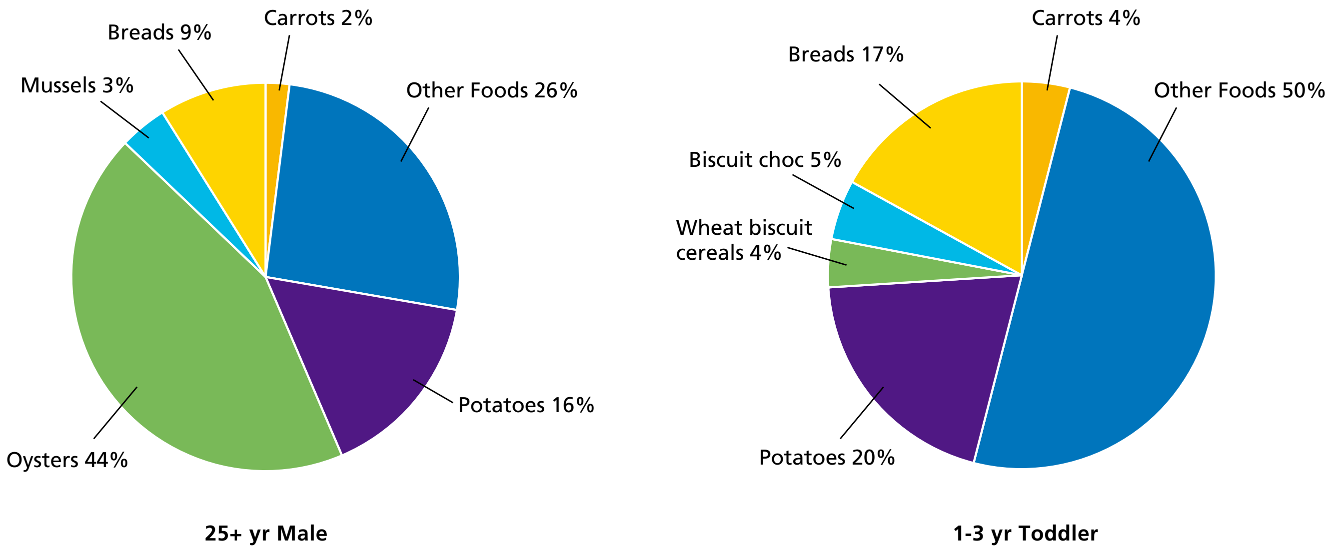
Figure 17 shows that consumption of one to two oysters per fortnight increases dietary exposure to cadmium by approximately 0.5-0.8 µg/kg bw/week (8-13% of PTWI) for the 19-24 year young male, and 25+ year male and female.

It should also be noted that the dietary exposures for cadmium in **Figure 17** are based on average energy consumption figures. Generally, high consumers at 95th percentile levels may approximate three times the population average consumption figure for individual foods, and up to twice the total amount consumed by the population as a whole (FAO/UNEP/WHO, 1985).

This would significantly increase their dietary exposure to cadmium. In extreme cases, some Bluff (dredge) oyster consumers have been reported to consume up to an average of 16 dozen/ week during the six month oyster season, equating to an exposure of ten times the PTWI (McKenzie-Parnell et al, 1988).

Figure 18 confirms that the contribution from oysters (44%) dominates dietary cadmium exposure for the 25+ year male. Potatoes and related products (16%), all breads (9%), mussels (3%) and carrots (2%) are the other specific foods which contribute significantly to dietary cadmium exposure of the 25+ year male. Thus only five specific foods contribute 74% of his weekly dietary cadmium exposure. Potatoes (20%), breads (17%), and carrots (4%) also contribute significantly to the estimated dietary cadmium exposure for the 1-3 year toddler. Without oysters in their simulated typical diet, wheat biscuit cereals (4%) and chocolate biscuits (5%) come through as other specific foods contributing to their dietary cadmium exposure. Cocoa, and related products such as chocolate and chocolate biscuits, are well recognised as a potential source of cadmium (Stenhouse, 1991).

Figure 18 Specific foods which contribute to estimated dietary exposure to cadmium in a 25+ year male and a 1-3 year toddler in the 2003/04 NZTDS



The cadmium content of New Zealand shellfish is probably of natural occurrence, although agricultural run-off may also be a factor. As filter feeders, shellfish can accumulate cadmium from the environment to very high levels (Peterson and Mortensen, 1994). Widely variant oyster cadmium levels (0.12-7.9 mg/kg) have been encountered in New Zealand, dependant on the sampling location. Oysters also contain high levels of zinc, iron and selenium (Nielsen and Nathan, 1975), which have been suggested as counteracting the absorption of cadmium in the body (Reilly, 1991). The Bluff (dredge) oysters in the 2003/04 NZTDS had the highest concentration of cadmium (5.3 mg/kg), with an associated iron concentration of 103 mg/kg iron and 0.52 mg/kg selenium, which were amongst the highest concentrations for each analyte for all foods in the 2003/04 NZTDS. Oysters were not analysed for zinc in the 2003/04 NZTDS, but in 1997/98, oysters contained 41-195 mg/kg of zinc.

Table 12 Estimated weekly dietary exposure (µg/kg bw/week) to cadmium for a 19-24 year young male in the 2003/04 NZTDS compared to previous NZTDSs and as a percentage of PTWI

Element	1982 NZTDS [a]	1987/88 NZTDS [b]	1990/91 NZTDS [c]	1997/98 NZTDS [d]	2003/04 NZTDS
Cadmium (diet incl'g oysters)	6.1	8.2	2.8	2.8	1.8
% of PTWI	87%	117%	40%	40%	26%
Cadmium (diet excl'g oysters)	3.3	4.0	2.3	1.7	1.3
% of PTWI	47%	56%	32%	24%	18%

a Pickston et al, 1985
b ESR/MoH, 1994
c Vannoort et al, 1995b
d Vannoort et al, 2000

Table 12 shows the 2003/04 NZTDS weekly dietary exposures to cadmium for a young male compared to previous NZTDSs. Exposure estimates also consider the simulated typical diets either including or excluding oysters. The 1990/91 NZTDS dietary exposure estimate (2.8 µg/kg bw/week, including oysters) was much lower than that of 1987/88 (8.2 µg/kg bw/week). This was attributable both to improved methodology (50 times lower limit of detection), and the significantly lower mean oyster concentrations encountered in 1990/91 (0.392 mg/kg) compared to 1987/88 (3.48 mg/kg). Bluff (dredge) oyster harvests were very small or non-existent in 1990/91 because of the bonamia parasite problem. The 10-fold lower cadmium oyster concentrations in the 1990/91 NZTDS suggest the oysters were probably entirely of a different type – Pacific or imported. In the 1997/98 NZTDS, Bluff (dredge) oysters were included and produced a mean oyster cadmium concentration of 4.48 mg/kg. This resulted in an estimated weekly dietary exposure to cadmium for a young male of 2.8 µg/kg bw/week. The 2003/04 NZTDS mean oyster concentration was 2.92 mg/kg, and contributed to an estimated weekly dietary exposure to cadmium for a young male of 1.8 µg/kg bw/week.

If oysters are excluded from the estimated dietary cadmium exposures, the impact of the 50 times lower limit of detection from 1987/88 to 1990/91 is still clearly evident, with exposures decreasing from 4.0 to 2.3 µg/kg bw/week. From 1990/91 to 2003/04, the limit of detection was essentially unchanged, and estimated weekly dietary exposure to cadmium for a young male has dropped from 2.3 to 1.7 to 1.3 µg/kg bw/week. This presumably reflects changes in dietary consumption and cadmium concentrations in key foods, especially staples **(see Table 11).**

Figure 19 Comparison of estimated weekly dietary exposure to cadmium for a 25+ year male in the 2003/04 NZTDS with overseas studies

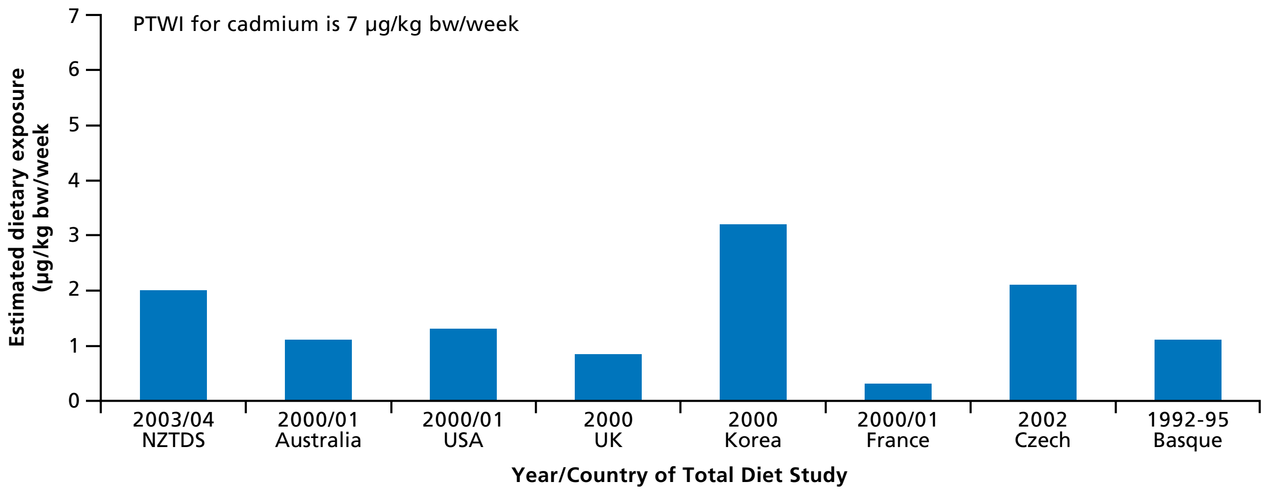


Figure 19 compares the 2003/04 NZTDS estimated weekly dietary exposure to cadmium for a 25+ year male (2.0 µg/kg bw/week) with those from TDSs of Australia, the USA, the UK, the Republic of Korea, France, the Czech Republic and the Basque Country. The cadmium exposure from foods in Australia (1.1, FSANZ, 2003); the USA (1.3, Egan, 2005); the UK (0.84, UK FSA, 2004); and the Basque Country (1.1 µg/kg bw/week, Jalon et al, 1997) are all lower than in New Zealand. The Czech Republic has an almost identical dietary exposure for its 18+ year male (2.1, Ruprich, 2003). Of the other countries considered, France reported the lowest weekly cadmium dietary exposures (0.3 µg/kg bw/week; Leblanc et al, 2005), while the Republic of Korea reported the highest (3.2 µg/kg bw/week; Kwon et al, 2001).

4.3.3 Lead (Pb)

Lead is ubiquitous in the environment and varies widely in concentration, although in most instances human or animal exposure can be reduced (Quarterman, 1986). Human exposure to lead is largely the result of pollution, particularly from alkyl lead fuel additives and lead-based paints. The concentration of lead in foods is extremely variable. In crops, the concentrations of lead reflect the level of pollution during the growing season. The use of lead solder in the manufacture of cans has in the past been a significant contributor to dietary intakes of lead (WHO, 1977; WHO, 1989a; Reilly, 1991). This manufacturing process has been discouraged and is now largely outmoded in New Zealand. However, imported canned food may use this technology.

Lead is a cumulative metabolic poison that targets the haematopoietic (blood cell producing) system, the nervous system, the male reproductive system and the kidneys. In addition, the foetus, infants and children are at particular risk. Blood levels greater than 10 µg/dL, that could result from polluted urban environments, have been shown to cause adverse effects, including neurobehavioural development problems (WHO, 1972; WHO, 1987a; WHO, 1993). United States Environmental Protection Agency (US EPA) evaluations have concluded there is no apparent threshold for the relationship between blood lead and neurobehavioural developmental deficiencies (US EPA, 1991).

Recently JECFA reconfirmed the PTWI for infants, children and adults at 25 µg/kg bw/week (WHO, 2000). This was concluded from conservative dose-response modelling that estimated diets containing lead consumed at "typical" or high concentrations would increase blood lead concentrations by 0.3 and 0.6 µg/dL, respectively. These were compared to estimated median population decreases of 0.4 and 1.7 of intelligent quotient (IQ) at 5 and 10 µg/dL of lead in blood, respectively, and provided confidence that levels of lead currently found in foods would have negligible effects on intellectual development. JECFA also noted that foods with high lead content remain in commerce, and that a full risk assessment of intake of lead should take into account other sources of exposure.

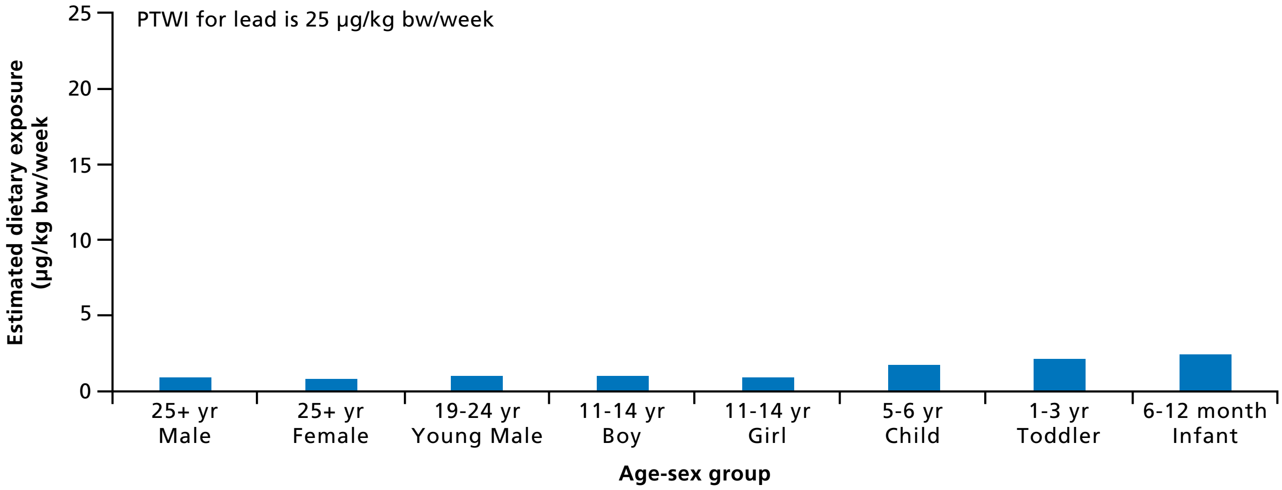
The concentrations of lead in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b, 2004 a,b,c). These data have been consolidated in **Auxiliary Data** report**, Appendix 8.3** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of lead for the 2003/04 NZTDS foods.

Almost all the individual 2003/04 foods making a contribution to dietary lead intake had mean lead levels consistent with, or lower than, recent overseas data (MAFF, 1998a; FSANZ, 2003). Canned foods, which in the past have been a major source of dietary lead, contained low lead levels reflecting widespread use of welded cans rather than lead soldered cans.

High levels of lead (0.47 mg/kg) were found in one brand of babyfood in one season of the 2003/04 NZTDS. This was subsequently shown to be due to lead contamination of cornflour, and sparked international recalls and associated risk assessment, risk management and risk communication (NZFSA, 2004).

The estimated weekly dietary exposures to lead for the eight age-sex groups of the 2003/04 NZTDS are given in **Table 7.** Exposures are expressed as µg/kg bw/week, and as a percentage of the PTWI.

Figure 20 Estimated weekly dietary exposures to lead for the eight age-sex groups of the 2003/04 NZTDS



The estimated weekly dietary exposures to lead for the eight age-sex groups of the 2003/04 NZTDS are also depicted in **Figure 20**. It is noted that weekly dietary lead exposures in New Zealand are now down to 1.0 µg/kg bw/week for a young male (3.8% of PTWI) and 2.4 µg/kg bw/week for an infant (9.5% of PTWI). When the anomalous 0.472 mg/kg lead in infant weaning food (custard/fruit dish) replaced the more usual concentration of 0.002 mg/kg, then the estimated dietary exposure for the infant rose to 2.9 µg/kg bw/week (11.7% of PTWI). The single tainted cornflour event did not increase the other age-sex groups' dietary exposures.

As can be seen from **Figure 20** and **Table 7**, dietary exposures to lead relative to body weight are highest for infants and young children, who are especially sensitive to the toxic effects of lead. Lead can be transported across the placenta, and may affect the developing foetus (Stevenson, 1990).

The ubiquitous environmental presence of lead resulted in most food groups contributing to dietary lead exposure for all age-sex groups. Grains contributed 24-27% of dietary lead for adults and 36-39% for children. Chicken, eggs, fish and meat; and takeaways contributed 12-16% and 9-24% of adult dietary lead, and 7-12%; 10-15% for children. The main food groups contributing to weekly dietary exposure to lead for infants are grain (18%), chicken, eggs, fish and meat (4%), takeaways (6%), fruit (18%) and infant formula and weaning foods (38%).

Figure 21 indicates a consistent downward trend in the weekly dietary exposures to lead for the 19-24 year young male over successive NZTDSs. The decrease of weekly dietary exposure to lead for the 19-24 year young male from 26 µg/kg bw/week in 1982 to 9.4 µg/kg bw/week in 1987/88 demonstrates the effectiveness of governmental risk management strategies. These have included encouraging the food industry to implement new canning technologies to eliminate the use of lead solder in canned foods, and by regulating the reduction of lead additives in retail petroleum products.

Figure 21 Trend in estimated dietary exposure to lead for a 19-24 year young male over NZTDSs

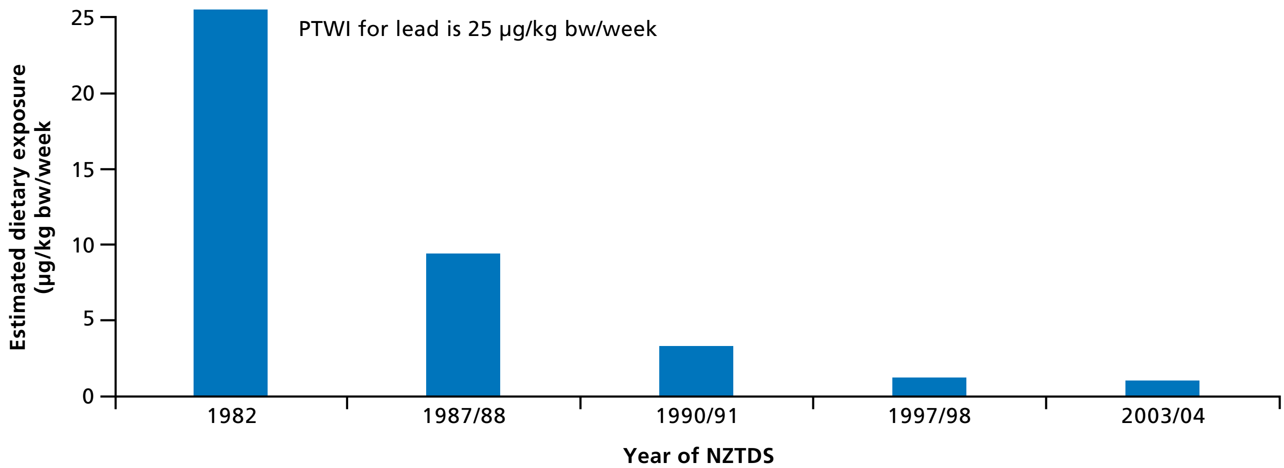


Table 13 Comparison of estimated weekly dietary exposure (µg/kg bw/week) to lead for a 25+ year male in the 2003/04 NZTDS with overseas TDSs

Element	**PTWI** µg/kg-bw/wk	**NZTDS 2003/04** Male 25+ yr	**Australia** Male 25-34 yr	**USA** Male 25-30 yr	**UK** Male	**France** Male	**Korea** Male	**China** Male 20-50	**Czech** Male 18+ yr	**Basque** Adult 25-60
Lead	25	0.9 [2]	1.6 [a2]	1.0 [b2]	0.7 [c3]	1.9 [d 2,5]	21.2 [e4]	13.8 [f1]	3.0 [g5]	2.9 [h3]

a 2000/01 data (FSANZ, 2003)
b 2000/01 data (Egan, 2005)
c 2000 data (UK FSA, 2004)
d 2000/01 data (Leblanc et al, 2005)
e 2000 data (Kwon et al, 2001)
f 2000 data (Gao, 2004)
g 2002 data (Ruprich, 2003)
h 1992-95 data (Jalon et al, 1997)
1 Using zero values for 'not detected' data
2 Using half limit of detection for 'not detected' data
3 Using limit of detection for 'not detected' data
4 Protocol for 'not detected' data not known
5 Using half limit of quantitation for 'not quantified' data

The decrease from 1987/88 (9.4 µg/kg bw/week) to 1990/91 (3.3 µg/kg bw/week) (Figure 21) was mainly the result of two factors. Firstly, a further reduction in the lead in petroleum products lowered environmental lead and thus lead concentrations in foods; and secondly the 10 times lower limit of detection offered by the use of ICP-MS technology meant significantly fewer 'not detected' foods (31 in 1990/91 versus 80 in 1987/88 NZTDS). This effectively reduces the degree of uncertainty associated with dietary exposure estimates caused by assigning half the limit of detection (LOD) to 'not detected' foods when calculating dietary exposures. In 1997/98, the LOD was the same as in 1990/91, and the lower weekly dietary exposure of 1.2 µg/kg bw/week in 1997/98 could be attributed to the complete removal of lead additives from retail petrol by the Government in 1996. In 2003/04, the LOD is essentially unchanged and dietary exposure to lead for a young male has dropped slightly to 1.0 µg/kg bw/week, and appears to be levelling out, presumably reflecting residual or natural environmental content of lead coming through in the food supply.

Table 13 shows that New Zealand now appears to have one of the lowest dietary exposures to lead for an adult male (0.9 µg/kg bw/week) when compared to Australia (1.6, FSANZ, 2003), the USA (1.1, Egan et al, 2002), the UK (0.7, UK FSA, 2004), France (1.9, Leblanc et al, 2005), the Czech Republic (3.0, Ruprich, 2003) and the Basque Country (2.9, Jalon et al, 1997). Two countries, the Republic of Korea (21.2 µg/kg bw/week, Kwon et al, 2001) and China (13.8, Gao, 2004) have much higher reported dietary exposure levels to lead.

4.3.4 Mercury (Hg)

Mercury is concentrated in the earth's crust into a relatively small number of rich ore belts associated with volcanic activity. Occupational hazards associated with both ingestion and inhalation have also been recognised for a long time (Clarkson, 1987).

Mercury and methylmercury are naturally occurring substances to which all living organisms are exposed, in varying degrees, depending on natural, biological, chemical, and physical processes. Mercury is used in the manufacture of electrical apparatus, paint, dental preparations and pharmaceuticals. Geothermal and volcanic activity influence the amount of mercury in the surrounding environment. The geothermal nature of much of New Zealand is the major contributor of mercury in our environment.

The metabolic behaviour of mercury varies greatly with the chemical form in which it is presented to the animal, the extent to which it interacts with other elements in the diet, and with genetic differences. Both inorganic and organic forms of mercury are found in food. The level of mercury in foods is variable and reflects the levels of contamination in the area of cultivation. Stock animals concentrate environmental mercury in the liver and kidney. The large predatory species of fish, such as sharks and swordfish, bioaccumulate mercury and may contain very high concentrations of the element (WHO, 1991a; WHO, 1991b; Reilly, 1991).

Organic mercury, particularly methylmercury (MeHg), is significantly more toxic than the inorganic form of mercury in foodstuffs. In seafood, mercury is most commonly found in the organic form, usually methylmercury. MeHg is a cumulative toxin that can cause disruption of the developing central nervous system, resulting in retarded mental and physical development (WHO, 1978a; WHO, 1989b; WHO, 1991a). The foetus and infants are much more sensitive than adults. While the placenta provides an effective barrier to the transfer of inorganic mercury, methylmercury is readily transferred across the placental barrier to the foetus (Clarkson, 1987). A study among the fish eating population of the Faroe Islands did find a positive correlation between measures of neurodevelopment and levels of mercury in cord blood at birth (Grandjean et al, 1997). In contrast, a similar study among the fish eating community of the Seychelles for in utero exposure to MeHg from maternal consumption of fish indicated that exposures of 5.18-11.2 µg/kg bw/week were not associated with any developmental delays up to nearly six years of age (Shamlaye et al, 1995).

JECFA set a total mercury PTWI of 5 µg/kg bw/week (WHO, 1972), which it reconfirmed in 1978 (WHO, 1978b). JECFA also set a PTWI for MeHg of 3.3 µg/kg bw/week in 1978 (WHO, 1978b), which has been revised twice, with the latest PTWI for MeHg being 1.6 µg/kg bw/week (WHO, 2004). This new PTWI is considered sufficient to protect developing foetuses, the most sensitive subgroup of the population. In light of the revised PTWI for MeHg, JECFA has also recommended that the PTWI for total mercury be revised (WHO, 2004).

In the 2003/04 NZTDS, total mercury was determined, not inorganic or MeHg. As is the practice overseas, only certain foods in the 2003/04 NZTDS were targeted for mercury analyses. This is because most foods do not have detectable mercury levels, and to analyse them is not an effective use of TDS resources. The United Kingdom also found that 30 out of the 37 foods they analysed for mercury had levels less than their 1 µg/kg detection limit (MAFF, 1997d).

Table 14 Estimated weekly dietary exposure (µg/kg bw/week) to total mercury for the eight age-sex groups of the 2003/04 NZTDS

Elements	Intl. Std (µg/kg bw/wk)	Male 25+ yr	Female 25+ yr	YM 19-24 yr	Boy 11-14 yr	Girl 11-14 yr	Child 5-6 yr	Toddler 1-3 yr	Infant 6-12 month
Mercury (total)	5[a] (1.6)[b]	0.74	0.60	0.74	0.74	0.46	1.1	1.3	1.3
% PTWI (total)		15%	12%	15%	15%	9%	21%	25%	26%
% PTWI (MeHg)		46%	38%	46%	46%	29%	69%	81%	81%

a WHO, 1978b
b WHO, 2004

The concentrations of mercury in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b, 2004 a,b,c). This data has been consolidated in the **Auxiliary Data** report, **Appendix 8.4** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of mercury for the 2003/04 NZTDS foods. Foods not analysed for mercury have also been identified in **Appendix 8.4.** In order to estimate total dietary exposures, a mean concentration was needed for each food. To achieve this, those foods 'not analysed' in the 2003/04 NZTDS were separately assigned a mean concentration value based on previous NZTDS or other New Zealand data (Vannoort et al, 2000).

The estimated weekly dietary exposures to total mercury for the eight age-sex groups of the 2003/04 NZTDS are given in **Table 14**. Exposures are expressed as µg/kg bw/week, and as a percentage of the PTWI. All exposures, based on ND=LOD/2 values (see **section 2.4.2**), fall below 26% of the PTWI for total mercury.

If, however, all the intake was considered to be MeHg, the dietary exposures would be up to 81% of the PTWI for toddlers and infants. Upper bound exposure estimates (based on ND=LOD) would be even higher.

Fish products contributed 74% of young male dietary mercury exposure and 65% of toddler dietary mercury exposure. It should be noted that 25% out of the remaining 26% of a young male's and 34% out of the remaining 35% of a toddler's dietary exposure to mercury from the non-fish foods is calculated using half LOD (explained in **section 2.4.2**). As a result, the 2003/04 NZTDS dietary exposures to mercury (**Table 14**) are likely to be somewhat overestimated because of the high proportion of 'not detected' foods, which have half the limit of detection assigned to them for the purposes of calculating dietary exposure (WHO GEMS/Food-Euro, 1995). The lower and upper bound dietary exposure estimates are given in **Table 7**, based on not detected foods assigned zero and LOD, respectively.

The concentrations of mercury in fish in the 2003/04 NZTDS were consistent with international literature. Most oceanic species have average mercury levels of about 0.15 mg/kg or less. However, large predatory species (shark, tuna, lemon fish) usually have mercury levels in the 0.20-1.5 mg/kg range (FAO/UNEP/WHO, 1988). In the 2003/04 NZTDS, battered fish had mercury concentrations up to 0.85 mg/kg.

Table 15 Estimated weekly dietary exposure (µg/kg bw/week) to total mercury for a 19-24 year young male in the 2003/04 NZTDS compared to previous NZTDSs and as a percentage of PTWI

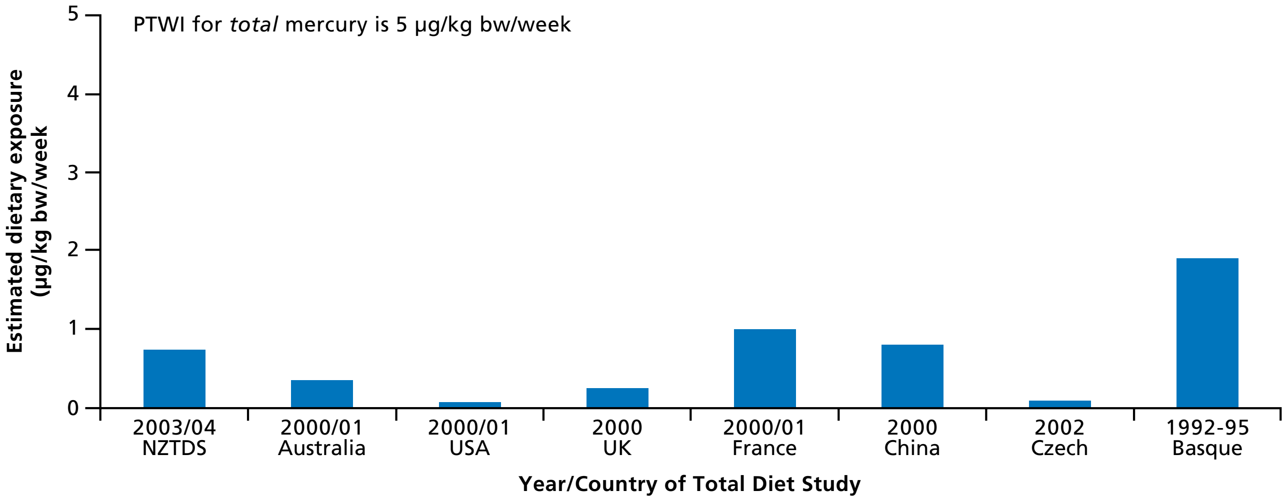
Element	1982[a] NZTDS	1987/88[b] NZTDS	1990/91[c] NZTDS	1997/98[d] NZTDS	2003/04 NZTDS
Mercury (total)	0.66	0.91	1.3	0.73	0.74
% PTWI (total)[e]	13%	18%	26%	15%	15%
% PTWI (MeHg)[f]	41%	56%	81%	47%	47%

a Pickston et al, 1985
b ESR/MoH, 1994
c Vannoort et al, 1995
d Vannoort et al, 2000
e PTWI (total) = 5; WHO, 1978b
f PTWI (MeHg) = 1.6; WHO, 2004

Table 15 shows that the weekly dietary exposure to total mercury for a young male increased from 0.91 µg/kg bw/week in the 1987/88 NZTDS to 1.3 µg/kg bw/week in the 1990/91 NZTDS. This was due to the contribution from seafood and the unexpected level of mercury found in imported tea (0.008 mg/kg) and the amount of tea consumed in the young male diet. In the 1997/98 NZTDS, the weekly dietary exposure to mercury for a young male was down again to 0.73 µg/kg bw/week, equivalent to 15% of the PTWI. The main reason was the much lower consumption of fish/seafood of 175g/week in 1997/98 NZTDS compared to 525 g/week in the 1990/91 NZTDS, and also the lower mean mercury content of tea (0.003 mg/kg). The 2003/04 estimated dietary exposure to mercury for a young male is the same as in 1997/98, despite a higher consumption of fish/seafood (250 g/week) in his simulated diet.

Figure 22 shows that the 2003/04 NZTDS weekly dietary exposure to mercury for a young male (0.74 µg/kg bw/week) is similar in magnitude to France (1.0, Leblanc et al, 2005) and China (0.8, Gao, 2004). The dietary exposure to mercury in the USA (0.07, Egan, 2005) is low probably because 'not detected' foods are assigned to zero and this approach is known to underestimate exposures. The Czech weekly dietary exposure to mercury (0.09, Ruprich, 2003) is an order of magnitude lower than New Zealand and the lowest estimated amongst other countries. This is explained by two reasons: the much lower consumption of fresh/saltwater fish and related products in the Czech Republic (67 g/av. person/week, Ruprich, 1999) compared to New Zealand (250 g/male/week, Brinsdon, 2004); and the Czech limit of detection (0.1-0.4 µg/kg) is also much lower than the 2003/04 NZTDS. The higher the LOD, the greater the extent of potential overestimation in any dietary exposure estimate, when non-zero values are assigned to 'not detected' concentration data. The UK, with an LOD intermediate between the Czech Republic and New Zealand, has a dietary exposure to mercury between the two countries. The Basque Country, with fish/seafood consumption of 623 g/Basque adult/week, had the highest estimated dietary exposure to mercury (1.9 µg/kg bw/wk, Jalon et al, 1997) of the overseas countries considered.

Figure 22 Comparison of estimated weekly dietary exposure to mercury for a 25+ year male in the 2003/04 NZTDS with overseas TDSs



4.4 Exposure Estimates for Contaminant Elements

The estimated weekly dietary exposures to arsenic, cadmium, lead and mercury for the eight age-sex group simulated typical diets in this survey were all within the PTWI. However, it should be noted that dietary exposures in the 2003/04 NZTDS were based on average energy diets for each of the age-sex groups. High percentile consumers have the potential to have significantly higher exposures.

Dietary exposure to arsenic is very low, being less than 4% of the PTWI for total arsenic, and less than 17% for inorganic arsenic.

Cadmium again represented the contaminant element in the New Zealand food supply with one of the highest estimated weekly dietary exposures, with the 5-6 year child and the 1-3 year toddler both being 37% of the PTWI.

Lead estimated weekly exposures have again reduced for all age-sex groups since the last NZTDS in 1997/98, to 3.8% of the PTWI for the 19-24 year male and 12% of the PTWI for 6-12 month infants. Dietary lead exposures in New Zealand are amongst the lowest in the world.

The dietary exposures to mercury for all age-sex groups were 26% or less of the PTWI for total mercury, and 86% or less of the PTWI for MeHg, and are dominated by consumption of fish and related products.

5 NUTRIENT ELEMENTS: RESULTS AND DISCUSSION

5.1 Introduction to Nutrient Elements

The nutrient elements iodine (I), iron (Fe), selenium (Se) and sodium (Na) were surveyed in the 2003/04 NZTDS. Iodine and selenium are core elements of past and present NZTDSs, enabling intake trends to be followed with time. Both are essential micronutrients that are deficient in New Zealand soils, resulting in low intakes for New Zealanders. The last two NZTDSs have found decreasing levels of iodine intake. Iodine is involved in thyroid function, and affects both mental and physical development (Hetzel and Maberly, 1986; Mann and Truswell, 1998). Recent research has indicated an increasing prevalence of iodine deficiency disorders in a sample of New Zealand children (Thomson, 2003).

Selenium is an antioxidant that plays a part in the body's defence mechanisms (Hoekstra, 1975; Garland et al, 1994).

Iron was included as an analyte of the 2003/04 NZTDS following stakeholder consultation. New Zealand has allowed the fortification of several grain-based foods since the mid-1990s. Knowledge of the impact of this fortification on iron intakes is limited. Collection of information on specific products would allow up to date information on iron intakes, and provide updated data for the New Zealand Food Composition Database.

Sodium was included as an analyte of potentially high intake based on the 1990/91 NZTDS (Hannah et al., 1995). Sodium had been identified as a nutrient element where high intakes are associated with increased risk of hypertension, a risk factor for cardiovascular disease, a key health concern for New Zealand.

5.2 Nutrient Element Results

The concentrations of iodine, iron, selenium and sodium in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b; 2004 a,b,c). This data has been consolidated in the **Auxiliary Data** report**, Appendix 9** (Vannoort and Thomson, 2005) detailing the minimum, maximum and arithmetic mean concentrations of these nutrients for the 2003/04 NZTDS foods.

A few foods were not analysed in the 2003/04 NZTDS because previous experience indicated levels would be non-detectable. These relate only to selenium and were the high fat foods margarine, oil and salad dressing, indicated by 'NA' in the 'number of samples analysed' column. For effective dietary exposure assessment and comparison of dietary exposures with other TDSs, a best estimate of dietary intake across all foods is desirable, so foods not analysed in the 2003/04 NZTDS were separately assigned a mean value based on previous New Zealand data (Vannoort et al, 2000).

Lower, mid and upper bound daily intake estimates of iodine, iron, selenium and sodium (μg/day or mg/day) for each age-sex group of the 2003/04 NZTDS are shown in **Table 16.**

The 2003/04 NZTDS nutrient intakes are also compared with Recommended Dietary Intakes (RDI) developed by a working party of New Zealand and Australian nutrition experts (NHMRC, 2005). These RDIs, currently in draft form, define levels of intake adequate to meet the known nutrient needs of all healthy people, and are based on the process and recommendations of the United States/Canadian Dietary Reference Intakes with regard to any unique aspects of populations in New Zealand and Australia and new evidence and recommendations from European countries and/or organisations.

In the absence of sufficient data from dose response studies, an estimated average requirement (EAR), and hence an RDI could not be derived for sodium. An adequate intake (AI) range has been assigned for sodium intake where the adequate intake is based on intakes by a group of apparently healthy people and can be used as a goal for individual intake (NHMRC, 2005). For sodium, an adequate intake for adults is within the range 460-920 mg/day to ensure that basic metabolic requirements are met and to allow for adequate intakes of other nutrients. For a 7-12 month infant, the AI is 170 mg/day. Upper intake limits (UIL), stating the highest level of continuing daily nutrient intake likely to pose no adverse health effects in almost all individuals, are also available for sodium and range from 2300 mg/day for adults to 1000 mg/day for a 1-3 year toddler (**Table 16**). Both adequate intakes and upper intake limits are draft values at the time of writing (NHMRC, 2005).

5.3 Nutrient Element Discussion

5.3.1 Iodine (I)

New Zealand soils are low in iodine, and goitre (a swelling of the thyroid gland) was endemic in many areas of New Zealand in the early 1900s prior to the introduction of iodised salt in 1924. Since the 1950s goitre has virtually disappeared. Iodine intakes also increased due to widespread use of iodine-containing iodophors, which were used as cleaning and sterilising agents by dairy companies. Milk has been an important source of iodine in New Zealand, however, a move away from the use of iodophors by the dairy industry (Sutcliffe, 1990; Knowles et al, 1997) has reduced mean levels of iodine in trim milk from 0.440 mg/kg (n=289) to 0.090 mg/kg (n=20) (Cressey and Vannoort, 1998) or 0.096 mg/kg (n=8) (**Auxiliary Data** report**, Table A9.1**, Vannoort and Thomson, 2005). This is significantly below that of the UK, where milk had a mean iodine concentration of 0.311 mg/kg (n=220) (UK FSA, 2000a), attributed to iodine present naturally in cows' milk, but also influenced by iodine animal feed and/or hygiene products used in the dairy industry.

Iodine is an essential micronutrient for all animals including humans (Hetzel and Maberly, 1986). About 70-80% of the body's iodine is found in the thyroid gland, which stores iodine and therefore reflects intake. It is present in food and water predominantly as iodide and is sometimes organically bound to amino acids. It is rapidly absorbed throughout the length of the gastro-intestinal tract. Dietary goitrogens, such as those found in cabbage, broccoli, cauliflower and cassava, can interfere with iodine metabolism by inhibiting the production of thyroid hormones.

Iodine's physiological importance relates to its function as a constituent of thyroid hormones necessary for growth and development. In the foetus, neonate and child, thyroid hormones influence cellular differentiation, growth and development (Hetzel and Maberly, 1986). Thyroid hormones also stimulate basal metabolic rate, oxygen consumption and heat production and are also required for the development and growth of the nervous system.

Iodine deficiency in childhood may lead to an inhibition of growth and development, resulting in disorders such as juvenile hypothyroidism, impaired mental function and retarded development. A relationship between iodine deficiency and the incidence of goitre has been unequivocally shown (Hetzel and Maberley, 1986).

The concentrations of iodine in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b, 2004 a,b,c). This data has been consolidated in the **Auxiliary Data** report**, Appendix 9.1** (Vannoort and Thomson, 2005), detailing the minimum, maximum a nd arithmetic mean concentrations of iodine for the foods analysed in the 2003/04 NZTDS. Most of these foods had iodine concentrations of less than 0.050 mg/kg.

There were three foods with elevated iodine content, namely a brand of soy milk (9.14 mg/kg, only one product line for one of the four brands sampled), mussels (3.34 mg/kg) and oysters (1.38 mg/kg). The latter two were in the expected range, but soy milk normally has less than 0.01 mg/kg iodine. In this instance, the 2003/04 NZTDS helped identify an unexpectedly and unacceptably high iodine concentration in the New Zealand food supply. The manufacturer was informed and the product reformulated. Eggs had a mean iodine content of 0.69 mg/kg compared with 0.54 mg/kg in 1997/98 (Vannoort, et al., 2000), 0.51 mg/kg in the UK TDS (MAFF, 1997b) and 0.48 mg/kg in the US TDS (Pennington and Young, 1995). Iodine is added via a mineral type premix to the rations of laying hens in New Zealand (Meads, 1999), and it is well recognised that such supplementation can raise the iodine content of eggs from 0.004-0.010 mg/kg by as much as a thousand fold (Hetzel and Maberley, 1986).

Daily intakes of iodine were calculated for normal levels of iodine in soy milk. There is little difference between lower and upper bound iodine intake estimates (**Table 16**) and mean estimates of iodine in each age-sex group are shown in Table 17. Assuming normal levels of iodine in soy milk, the estimated mean intakes in the 2003/04 NZTDS were significantly lower than the RDI for all age-sex groups. Iodine intake varied from a low of only 40%, for a 25+ year female to a high of only 57% of the RDI for a 25+ year male. When the anomalously high levels of iodine found in one product line in one of four brands of soy milk were included, the intakes increased accordingly but all remained well below the RDI.

Table 16 Daily intakes of nutrient elements for each age-sex group in the 2003/04 NZTDS

Nutrient Elements	25+ yr Male	25+ yr Female	19-24 yr Young Male	11-14 yr[c] Boy	11-14 yr[c] Girl	5-6 yr[d] Child	1-3 yr Toddler	6-12 month[e] Infant
Iodine intake (µg/day) (& normal iodine soy milk)	83 - 85 - 86[a]	59 - 60 - 61	84 - 85 - 86	59 - 60 - 61	49 - 50 - 51	43 - 43 - 44	47 - 47 - 48	49 - 49 - 49
(one high iodine soy milk)*	116 - 117 - 119 *	96 - 98 - 99 *	98 - 99 - 100 *	73 - 74 - 75 *	73 - 73 - 74 *	57 - 57 - 58 *	56 - 57 - 57 *	49 - 49 - 49
RDI (µg/day)[b]	150	150	150	120	120	90	90	110 (AI, not RDI)
UIL (µg/day)[b]	1100	1100	1100	600	600	300	200	unable to be set
Iron intake (mg/day)	12.7 - 12.8 - 12.9	9.1 - 9.1 - 9.2	13.2 - 13.3 - 13.4	11.8 - 11.9 - 11.9	9.2 - 9.3 - 9.3	8.0 - 8.0 - 8.0	5.8 - 5.8 - 7.1	7.1 - 7.1 - 7.1
RDI (mg/day)[b]	8	18	8	8	8	10	9	11
UIL (mg/day)[b]	45	45	45	40	40	40	20	20
Selenium intake (µg/day)	63 - 67 - 71	46 - 49 - 52	67 - 71 - 74	53 - 55 - 58	39 - 41 - 43	30 - 32 - 34	20 - 21 - 22	15 - 16 - 17
RDI (µg/day)[b]	70	60	70	50	50	30	25	15 (AI, not RDI)
UIL (µg/day)[b]	400	400	400	280	280	150	90	60
Sodium intake (mg/day)	3047	2150	3603	3108	2496	2031	1384	845
AI (mg/day)[b]	460-920	460-920	460-920	400-800	400-800	300-600	200-400	170
UIL (mg/day)[b]	2300	2300	2300	2000	2000	1400	1000	unable to be set

a Lower, mid and upper bound estimates based on assigning zero, LOD/2 and LOD, respectively, to non-detects
b Draft Australian and New Zealand Nutrient Reference Values (NHMRC, 2005): RDI = Recommended Daily Intake; UIL = Upper Intake Limit; AI = Adequate Intake
c Nutrient reference values for 11-14 year children extrapolated from values for 9-13 year children
d Nutrient reference values for 5-6 year children extrapolated from values for 4-8 year children
e Nutrient reference values for 6-12 month infants extrapolated from values for 7-12 month infants, except 'f'
f UIL for 6-12 month infant extrapolated from 0-12 month infant
** Includes anomalous result due to iodine contamination in one brand of soy milk*

Table 17 Estimated mean dietary iodine intake (µg/day) for the eight age-sex groups of the 2003/04 NZTDS

Iodine intake (µg/day)	25+ yr Male	25+ yr Female	19-24 yr YM	11-14 yr Boy [d]	11-14 yr Girl [d]	5-6 yr Child [e]	1-3 yr Toddler	6-12 month Infant [f]
2003/04 NZTDS (normal soy milk) [a]	**85**	**60**	**85**	**60**	**50**	**43**	**47**	**49**
(high soy milk) [a*]	117*	98*	99*	74*	73*	57*	57*	49*
RDI [b] (µg/day)	150	150	150	120	120	90	90	110 (AI, not RDI)
Intake as % of RDI	**57%**	**40%**	**57%**	**50%**	**42%**	**48%**	**52%**	**45%**
UIL [c] (µg/day)	1100	1100	1100	600	600	300	200	unable to be set

* *includes anomalous result due to iodine contamination in one brand of soy milk*

a *The intake for each age-sex group is based on assigning not detected results to half LOD (as explained in section 2.4). For upper and lower bound intake estimates, based on assigning ND=0 and ND=LOD/2, see* **Table 16**.

b *Recommended Daily Intake (draft) (NHMRC, 2005)*

c *Upper Intake Limit (draft) (NHMRC, 2005)*

d *Nutrient reference values (NRV) for 11-14 year boy/girl extrapolated from values for 9-13 year children*

e *NRVs for 5-6 year child extrapolated from 4-8 year child*

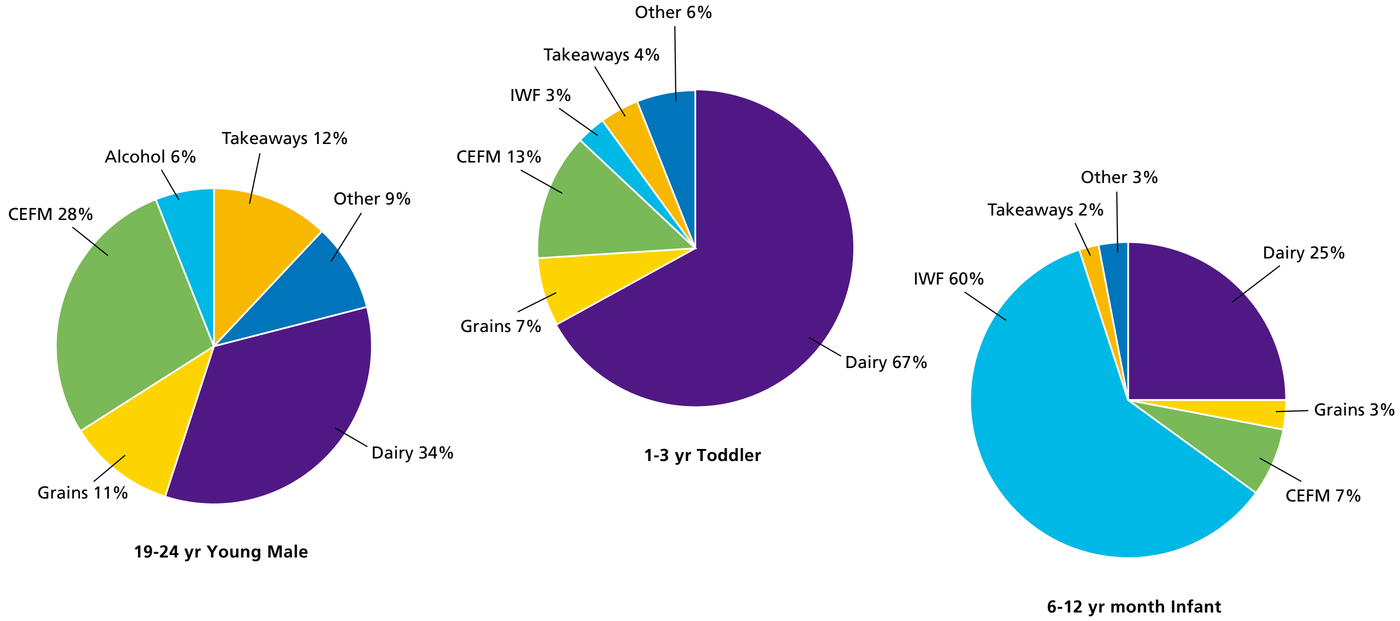
f *NRVs for 6-12 month infant from 7-12 month infant*

It is important to note that consistent with previous NZTDSs, the 2003/04 NZTDS did not take into account the addition of discretionary salt used either during cooking, or added at the table. Given that 70% of table salt is iodised in New Zealand (Sutcliffe, 1990), actual iodine intakes of New Zealanders are probably higher than those indicated in **Tables 16** and **17.**

Daily iodine intakes of more than 2,000 µg/day would be considered excessive and potentially harmful (Hetzel and Maberly, 1986). Draft upper intake limits for iodine range from 200 µg/day for a toddler to 1,100µg/day for adults (NHMRC, 2005). In the 2003/04 NZTDS, potential toxicity from iodine intakes is clearly not an issue.

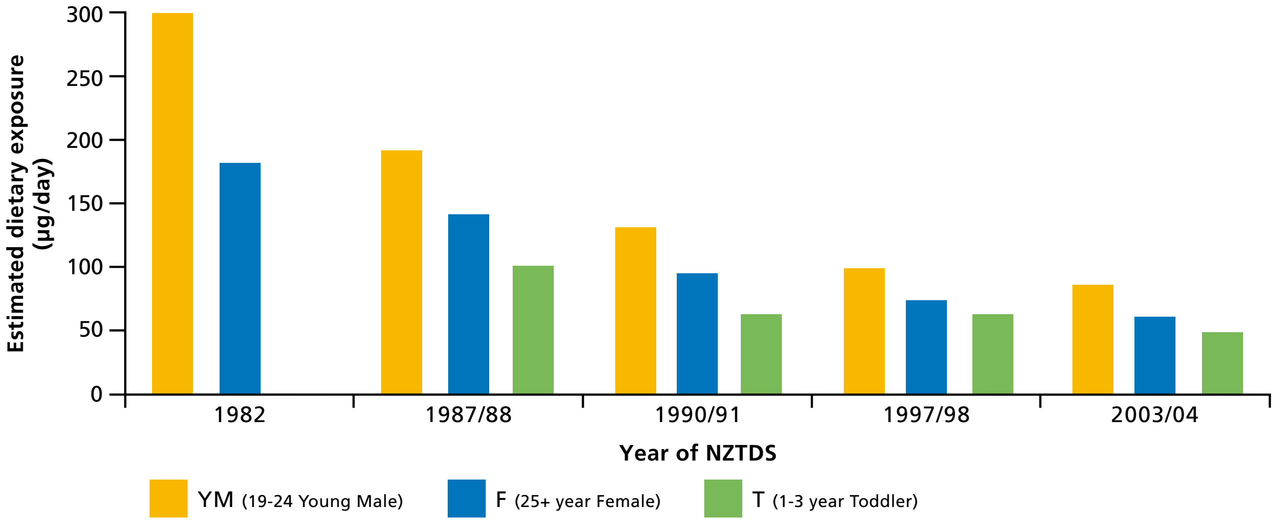
Figure 23 shows that dairy foods still make the most significant contribution to iodine intake (67%) for a 1-3 year toddler. A combination of dairy foods and other animal sources (eggs, mussels, fresh fish and oysters) provided the most significant proportion of iodine in the diet of a 19-24 year young male. A similar pattern of distribution was observed for a 25+ year male and female, 11-14 year boy and girl (not shown), although only a 25+ year male and 19-24 year young male gain 5-6% of iodine intake from beer consumption. Intake of iodine for a 6-12 month infant is dominated by levels in infant and follow on formula.

Figure 23 Food groups which contribute to estimated dietary iodine intake in a 19-24 year young male, 1-3 year toddler and 6-12 month infant in the 2003/04 NZTDS



Key
CEFM = Chicken, Eggs, Fish, Meat
IWF = Infant formulae & Weaning Foods

Figure 24 Trend of estimated dietary iodine intake (µg/day) for a 19-24 year young male (YM), 25+ year female (F) and 1-3 year toddler (T) over five NZTDSs from 1982-2003/04



Intake estimates from the NZTDSs since 1982 (**Figure 24**), which are based on simulated typical diets, show that the iodine intake of New Zealanders has continued to decrease for all age-sex groups to a point where iodine intakes are, at best, only 57% of the RDI across the eight population groups. The reduction in dietary iodine intakes is consistent with New Zealand studies showing urinary iodide levels, and hence iodine status, is decreasing (Thomson et al, 1995; 1997).

Concern about low intakes of iodine in New Zealand has already lead to its inclusion as a core nutrient in the New Zealand Food Composition Database, to assessing the iodine status of New Zealanders (Thomson et al, 1997; Skeaff et al, 1997; 1999) and a study investigating the iodine content of dairy foods (Cressey and Vannoort, 1998). Median urinary iodide measurements of New Zealand adults and children indicate that iodine status has declined from the 1980s to the 1990s and 2000s with a possible re-emergence of mild to moderate iodine deficiency (Thomson, 2003).

The estimated daily intakes of 85 and 60 µg/day for a 19-24 year young male and 25+ year female respectively in the 2003/04 NZTDS are about one third that of a UK adult (250 µg/day, UK FSA, 2000). Mean daily iodine intakes of 45.3 and 107 µg/day have been reported for German males with corresponding mean female intakes of 44.2 and 102 µg/day respectively (SCF, 2002). The reason for the discrepancy between the two sets of estimates is unclear. In Denmark and The Netherlands, median intakes of about 119 and 145 µg/day for males and 92 and 133 µg/day for females have been reported respectively (Petersen and Mortensen, 1994; van Dokkum et al, 1989). Apart from the UK results, all adult consumers have lower than recommended dietary intakes of iodine.

5.3.2 Iron (Fe)

About 60% of iron in the body is contained in haemoglobin, the complex that transports oxygen around in the blood. It is also an important part of myoglobin in the muscle cells, and a number of enzymes within the cells. Iron deficiency, due to an inadequate dietary intake, continues to be probably the most important of the nutrient deficiency disorders in the world. Iron deficiency may cause anaemia, and may also detrimentally affect work capacity, intellectual performance and behaviour. Resistance to infection and thermoregulation has also been shown to be affected in iron deficient states (DOH, 1991).

The concentrations of iron in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b, 2004 a,b,c). This data has been consolidated in an **Auxiliary Data report, Appendix 9.2** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of iron for the foods analysed in the 2003/04 NZTDS.

Most foods contained less than 50 mg/kg iron. The highest concentration of iron was found in yeast extract and lambs liver at 446 and 435 mg/kg, respectively. A number of cereal products, namely bran flake cereal, cornflakes, cereal-based infant weaning food and wheat biscuit cereals, had maximum iron levels above 100 mg/kg. Mussels and oysters also had maximum iron concentrations above 100 mg/kg.

Mean daily intakes of iron for each age-sex group in the 2003/04 NZTDS are shown in **Table 18**.

Dietary intakes of iron are adequate for 25+ year males, 19-24 year young men, and 11-14 year boys and girls living in New Zealand. However, the average intake of iron for 25+ year females in New Zealand is only about half the RDI. Iron intakes for a 5-6 year child, a 1-3 year toddler and 6-12 month infants are also below the RDI.

It is well known that intakes of iron in terms of mg/day do not necessarily reflect the bioavailability of the nutrient. The RDI for iron in most countries, where a mixture of animal and vegetable foods are traditionally consumed, such as New Zealand and Australia, assume that iron will be taken in both its haem and non-haem forms. These two forms are absorbed by different mechanisms, with haem iron being more readily absorbed. All the iron in vegetable products and about 60% of the iron in animal tissues is in the non-haem form, and the ability of this type of iron to be absorbed is dependent on several factors. The two most important enhancers of non-haem absorption are the presence of ascorbic acid (vitamin C) and the presence of meat. Some dietary components substantially inhibit the absorption of non-haem iron and these are calcium, phosphate, phytates, polyphenols, such as tannin in tea, and fibre. Overall, non-haem iron absorption may vary up to tenfold, depending on the dietary content of such inhibiting and enhancing factors (Roeser, 1990).

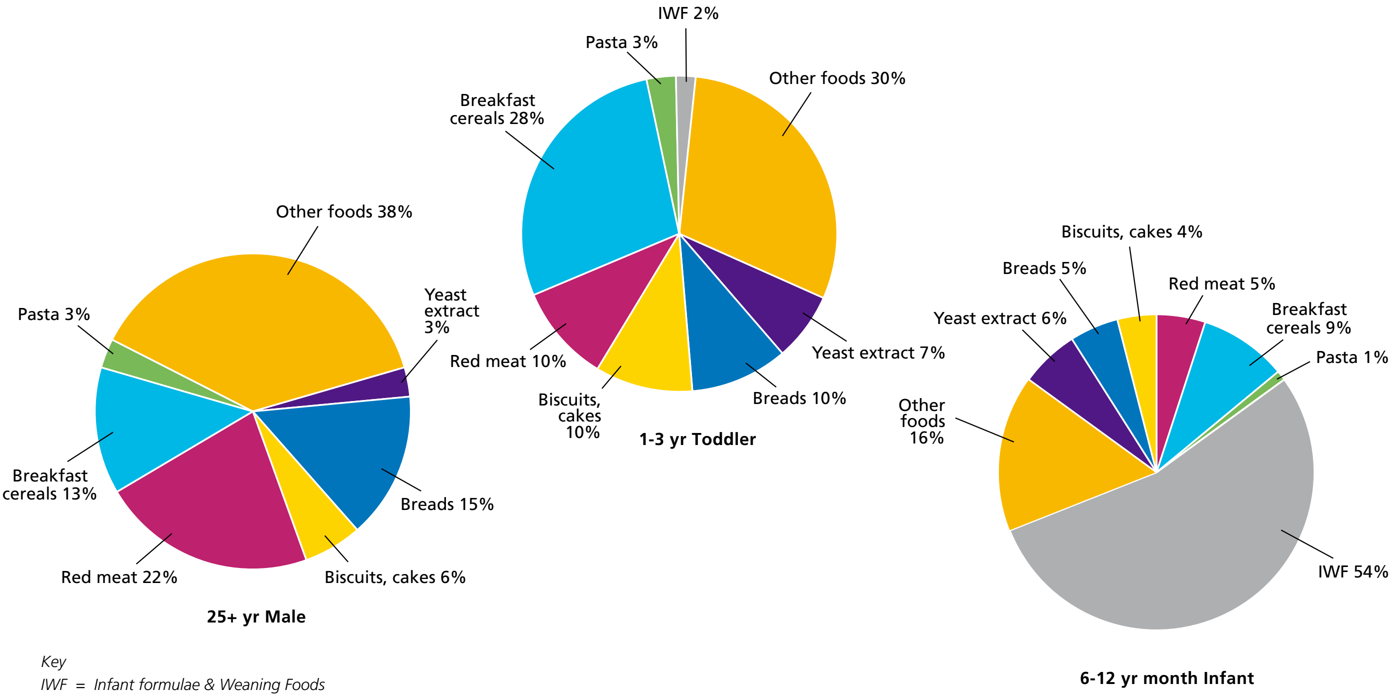
Whilst it must be recognised that to measure nutritional status, biochemical measurements would also be desirable, it is apparent from the 2003/04 survey findings, that even with fortification of cereals with iron, the RDIs for iron are not being achieved by females and children under 6 years. Iron intakes for all age-sex groups in the NZTDS are within the range of 20-36% of upper intake limits and therefore do not represent a toxicological risk from too much iron.

Table 18 Estimated dietary iron intake (mg/day) for the eight age-sex groups of the 2003/04 NZTDS

Iron intake (mg/day)	25+ yr Male	25+ yr Female	19-24 yr YM	11-14 yr Boy [d]	11-14 yr Girl [d]	5-6 yr Child [e]	1-3 yr Toddler	6-12 month Infant [f]
2003/04 NZTDS [a]	12.8	9.1	13.3	11.9	9.3	8	5.8	7.1
RDI [b] (mg/day)	8	18 [g]	8	8	8	10	9	11
Intake as % of RDI	160%	51%	166%	149%	116%	80%	64%	65%
UIL [c] (mg/day)	45	45	45	40	40	40	20	20 [h]
Intake as % of UIL	28%	20%	30%	30%	23%	20%	29%	36%

a The intake for each age-sex group is based on assigning not detected results to half LOD (as explained in section 2.4)
b Recommended Daily Intake (draft) (NHMRC, 2005)
c Upper Intake Limit (draft) (NHMRC, 2005)
d Nutrient reference values (NRV) for 11-14 year boy/girl extrapolated from values for 9-13 year children
e NRVs for 5-6 year child extrapolated from 4-8 year child
f NRVs for 6-12 month infant from 7-12 month infant
g for 19-50 years, for >51, RDI=8
h UIL extrapolated from 0-12 month infant

Figure 25 Food groups which contribute to estimated dietary iron intake in a 25+ year male, 1-3 year toddler and 6-12 month infant in the 2003/04 NZTDS



Key
IWF = Infant formulae & Weaning Foods

Food groups and specific foods that contributed to the iron intake for the 25+ year male, 1-3 year toddler and 6-12 month infant are shown in **Figure 25**. Grain products and red meat (beef and lamb) are important contributors to iron intake for 25+ year males and females, 19-24 year young males, and 11-14 year boys and girls. Breakfast cereals (particularly wheat biscuit cereals and cornflakes), yeast extract and breads are the major contributors to the intake of a 1-3 year toddler; and infant formula and weaning foods, yeast extract and breakfast cereals (largely wheat biscuit cereals) are the four major contributing foods for a 6-12 month infant.

A comparison of mean iron intake data for a 25+ year female and 19-24 year young male over the 20 year period from 1982 suggests that intake for 25+ year females has changed little over this period (**Table 19**). There is, however, a marked decline in intake for a 19-24 year young male between 1990/91 and 2003/04. The reason for this is not apparent since a reduced intake from wholemeal bread and lambs liver is more than offset by increases from fortified cereals and takeaways.

Table 19 Comparison of mean daily iron intake (mg/day) for a 25+ year female and 19-24 year young male from 1982 to 2003/04.

	1982 NZTDS	1987/88 NZTDS	1990/91 NZTDS	2003/04 NZTDS
25+ year female	10.9	10	12	9.1
19-24 year young male	18	16	19	13.3

5.3.3 Selenium (Se)

The main established function of selenium is as an essential factor for the enzyme glutathione peroxidase, which is an important component of the body's antioxidant defence system (Hoekstra, 1975). Selenium has also been demonstrated to inhibit cell proliferation that may provide an additional mechanism for cancer protection (Garland et al, 1994). Selenium deficiency has been linked to Keshan's cardiomyopathy and Kashin-Beck disease. This has been observed in areas of China where intakes are very low (3-22 µg/day, Levander and Burk, 1994).

Selenium varies greatly in its soil concentration around the world and this in turn relates directly to its concentration in food. New Zealand soils are generally considered to be low in selenium. Animals are drenched with selenium enriched products in low selenium areas in New Zealand to maintain fertility and prevent white muscle disease in stock. Seafood and meats, in particular kidney and liver, are consistently good sources of selenium, whereas the levels of selenium in grains and other seeds depend on the concentration of selenium in soils, which can vary greatly from one country to another (WHO, 1987b).

The absorption of selenium occurs primarily in the duodenum (small intestine), with selenium being equally well absorbed by selenium deficient and selenium loaded subjects (Levander, 1986). There is relatively little information about the possible interaction of selenium with other elements.

The concentrations of selenium in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b, 2004 a,b,c). This data has been consolidated in the **Auxiliary Data** report**, Appendix 9.3** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of selenium for the foods analysed in the 2003/04 NZTDS.

Table 20 Mean selenium concentrations (mg/kg) of key foods in the 2003/04 NZTDS compared to previous NZTDSs and overseas levels

Food (n)	1987/88 NZTDS[a]	1997/98 NZTDS[b]	2003/04 NZTDS[c]	00/01 ATDS[d]	1991-96 US TDS[e]
Bread, white (4 NI, 4 SI)	0.060	0.094 (NI) 0.025 (SI)	0.066 (NI) 0.005 (SI)	0.124	0.200
Wheat biscuit cereals (8)	<0.020	0.033	0.031	NS	0.046
Milk, whole (8)	<0.020	0.014	0.007	0.022	<0.040
Egg, boiled (8)	0.170	0.391	0.269	0.284	0.282
Chicken nuggets (8)	0.070	0.163	0.109	0.245	0.201
Pork chops (8)	0.070	0.165	0.137	NS	0.453
Beef mince (8)	0.020	0.072	0.057	0.141	0.199
Lamb/mutton (8)	0.050	0.103	0.053	0.203	0.258
Fish fingers (8)	0.210	0.253	0.255	0.709	0.165
Peanut butter (8)	0.030	0.086	0.129	0.112	0.081

a ESR/MoH, 1994
b Vannoort et al, 2000
c Appendix 9, Vannoort and Thomson, 2005
d FSANZ, 2003
e Capar and Cunningham, 2000
n number of samples
NI = North Island of New Zealand
SI = South Island
NS = not sampled

Table 20 summarises comparative data for some of the key individual foods contributing to selenium intake estimates between the current Survey and former NZTDSs, the 20th Australian Total Diet Study (FSANZ, 2003) and consolidated US Total Diet Study data (Capar and Cunningham, 2000). The table shows that animal products (eggs, chicken, pork, beef and lamb) appear to have selenium levels that are intermediate between the 1997/98 and 1987/88 studies. The selenium concentrations for 2003/04 NZTDS foods are all lower than concentrations reported for either Australia, USA or both (Table 20).

Table 21 shows the estimated intakes of selenium in the 2003/04 NZTDS. For a 19-24 year young male, it was 71 µg/day and for a 25+ year male, 67 µg/day. Both have the same RDI of 70 µg/day. The estimated intake for a 25+ year female was 49 µg/day, slightly below the draft RDI of 60 µg/day. The mean intake for an 11-14 year boy was above the RDI, whereas for a 11-14 year girl it was 18% below, attributable to a lower consumption of fresh fish. Mean intakes of selenium for a 5-6 year child, 1-3 year toddler and 6-12 month infant approximated the RDIs.

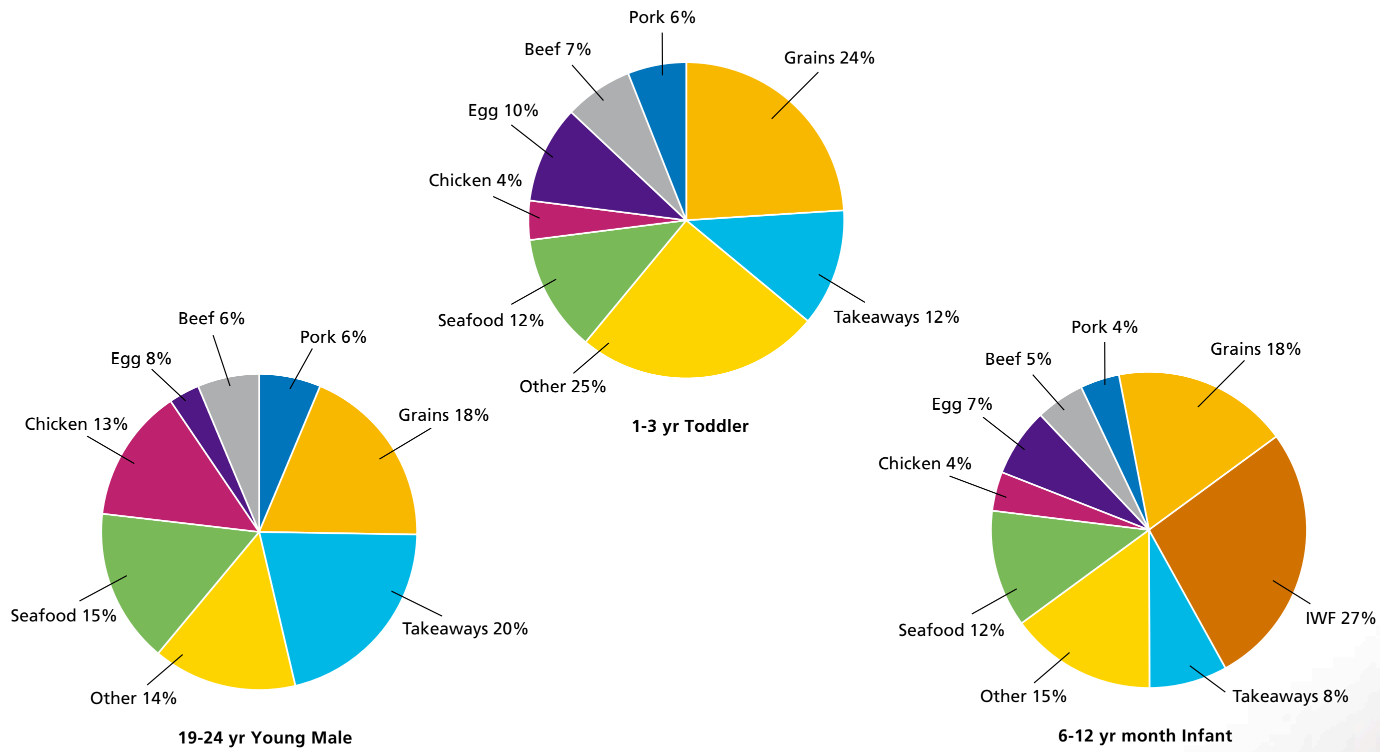
An intake of up to 400 µg selenium per day is considered safe for adults, with correspondingly lower UIL for younger people (NHMRC, 2005). The 2003/04 NZTDS confirms that selenium intakes do not constitute a toxicity problem for any of the New Zealand age-sex groups.

Table 21 Estimated dietary selenium intake (µg/day) for the eight age-sex groups of the 2003/04 NZTDS

Selenium intake (µg/day)	25+ yr Male	25+ yr Female	19-24 yr Young Male	11-14 yr Boy [d]	11-14 yr Girl [d]	5-6 yr Child [e]	1-3 yr Toddler	6-12 month Infant [f]
2003/04 NZTDS [a]	67	49	71	55	41	32	21	16
RDI [b] (µg/day)	70	60	70	50	50	30	25	15 (AI, not RDI)
UIL[c] (µg/day)	400	400	400	280	280	150	90	60

a The intake for each age-sex group is based on assigning not detected results to half LOD (as explained in section 2.4).
b Recommended Daily Intake (draft) (NHMRC, 2005)
c Upper Intake Limit (draft) (NHMRC, 2005)
d Nutrient reference values (NRV) for 11-14 year boy/girl extrapolated from values for 9-13 year children
e NRVs for 5-6 year child extrapolated from 4-8 year child
f NRVs for 6-12 month infant from 7-12 month infant

Figure 26 Foods which contribute to estimated dietary selenium intake in a 19-24 year young male, 1-3 year toddler and 6-12 month infant in the 2003/04 NZTDS

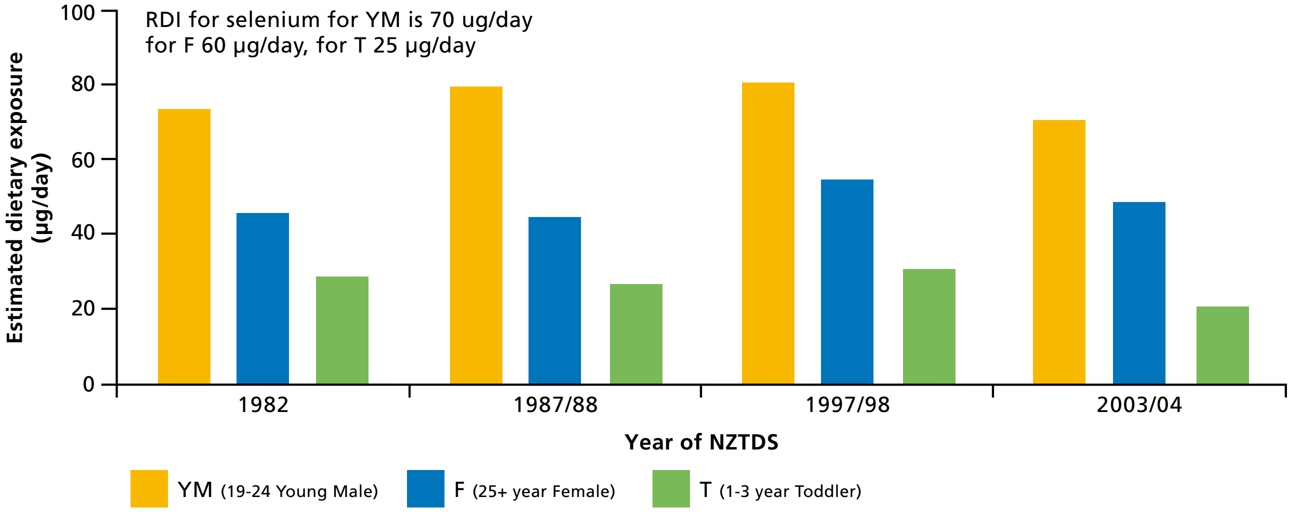


Key
IWF = Infant formulae & Weaning Foods

Seafood, chicken, eggs, breads and grain products provide the majority of selenium in the diets of all age-sex groups included in the 2003/04 NZTDS except for a 6-12 month infant for whom infant weaning foods contribute nearly 30%. Figure 26 illustrates the sources of selenium in the diet of a 19-24 year young male, a 1-3 year toddler and a 6-12 month infant. The distribution of foods providing selenium in the diet of a 25+ year male is also representative of a 25+ year female and a 19-24 year young male. Adolescent boys and girls (11-14 years) show lower contributions from fish (both fresh and battered) and cake than their adult counterparts but higher contributions from chicken and white bread, reflecting a preference for these foods by these population groups. Chicken feed and supplements specifically include selenium and that accounts for eggs as a key contributor to selenium intake (Catherwood, 1999; Meads, 1999).

Figure 27 shows estimates of selenium intake from four NZTDSs for the 19-24 year young male, 25+ year female and 1-3 year toddler age-sex groups. The apparent increase in selenium intake estimate for the 25+ year female and 1-3 year toddler reported in the 1997/98 NZTDS have not been maintained. Across each population group, selenium intakes have been steady over a 20 year period. This finding is at variance with a reported increase in selenium (Winterbourn et al, 1992; Thomson and Robinson, 1996), that was attributed to increased consumption of wheat imported from areas richer in selenium, and the use of livestock supplements (Vannoort et al, 2000).

Figure 27 Trend of estimated dietary selenium intake in a 19-24 year young male (YM), 25+ year female (F) and 1-3 year toddler (T) over NZTDSs



As **Figure 26** shows, grain products significantly influence selenium intake. The selenium content of breads presented in **Table 22** does seem to suggest a geographical difference, with South Island (Christchurch and Dunedin) breads containing less selenium than North Island (Auckland and Napier) breads. The South Island breads have a selenium content even lower than a previous study by Thomson and Robinson (1990) of Otago (lower South Island) breads. This is consistent with the fact that most of the grain used in the South Island is grown there, under low soil selenium conditions. Following deregulation of New Zealand's grain industry, North Island breads are likely to contain more imported grain from Australia or North America, and breads sampled in Q3 have a selenium content more consistent with the breads in the 2000/01 ATDS (FSANZ, 2003).

The difference in selenium levels between Q1 and Q3 for the North Island samples suggests different grain sources at different time periods, with more low selenium South Island grain used in the July/August 2003 period than in January/February 2004.

While the importation of wheat from higher selenium areas (such as Australia or North America) and use of supplements for livestock continues, it is likely that selenium intakes should remain satisfactory in the North Island. However, New Zealand's low selenium soil levels means that if these practices change, selenium intakes could again drop significantly. As has been pointed out previously, South Island breads are usually made with locally grown grain and thus appear to be lower in selenium (**Table 22**), so lower selenium intakes amongst South Islanders are likely.

Table 22 Selenium content of breads (mg/kg) sampled in the 2003/04 NZTDS in different geographic regions and seasons.

Bread type	Auckland		Napier		Christchurch		Dunedin		00/01 ATDS	Thomson & Robinson
	Q1 [a]	Q3 [b]	Q1	Q3	Q1	Q3	Q1	Q3		1990
White	0.022	0.101	0.038	0.102	<0.010	<0.010	<0.010	<0.010	0.124	0.010
Mixed grain	0.050	0.073	0.042	0.093	<0.010	0.016	<0.010	0.015	0.130	0.018
Wheatmeal	0.054	0.131	0.046	0.099	<0.010	0.010	<0.010	0.010		0.030

a Sampled in season Q1 (July/August 2003) *b Sampled in season Q3 (January/February, 2004)*

Intakes of selenium for Australian population subgroups are higher than New Zealand's by up to 50%, with mean estimated daily exposures to selenium of 96-116 µg/day for 25-34 year males in Australia, and 37-42 µg/day for their 2 year toddlers (FSANZ, 2003). The USA also has much higher dietary selenium intakes than New Zealand, with 140-150 µg/day for a 25-30 year US male (Egan, 2005), and 49-56 µg/day for their 2 year toddler (Egan et al, 2002). By assuming average body weights of 82 kg and 13 kg for adults and toddlers respectively, the UK 2000 TDS resulted in mean daily intakes of selenium of 53 µg/day for 19-64 year adults, and 18 µg/day for 1.5-4.5 year toddlers (UK FSA, 2004). New Zealand intakes are higher than those reported for the 50th percentile of consumers in the first French TDS, where intakes were 40 µg/day for 15+ year adults and 30 µg/day for 3-14 year children (Leblanc et al., 2005). A daily intake of 63 µg/day has been reported for males and 35 µg/day for females in the Czech Republic (Ruprich, 2003).

Estimated dietary selenium intakes for a 25+ year male in the 2003/04 NZTDS are graphically compared to adult males in overseas studies in **Figure 28**.

Selenium intake estimates for China are quite variable, with some of the variability relating to the methodologies used. Mean daily intakes of 80 and 53 μg/day were estimated for urban and rural adult women respectively, from 24-h duplicates of food collected from six cities and four villages. Estimates based on food composition tables were 37 and 33 μg/day for the urban and rural women, respectively (Zhang et al, 2001). Both of these estimates are considerably higher than the intake of 14 μg/day previously reported for Chinese men based on a TDS (Chen et al, 1994). China is known to have very low selenium intakes in certain regions, with Keshan cardiomyopathy evident (Hunt and Groff, 1990). Uneven distribution of selenium may account for these discrepancies and highlights a limitation of using national food composition data for regional intake estimates (Zhang et al, 2001), as well as the importance of representative sampling design in TDS based estimates.

Intake of selenium in New Zealand is low compared with Australia and the USA, comparable to the UK and parts of China, and higher than France, and other regions of China.

5.3.4 Sodium (Na)

The principal cation in extracellular fluid is sodium. Its physiological roles are closely linked to those of potassium and include the maintenance of extracellular fluid volume, acid-base balance, the active transport of molecules across cell membranes, transmission of nerve impulses, and the contraction of muscles (Mann and Truswell, 1998; NHMRC, 2005).

Sodium levels in the body are maintained by the kidneys so that increased or decreased salt intake does not usually increase the amount in the body (Mann and Truswell, 1998). The major adverse effect of increased sodium chloride intake is elevated blood pressure, a risk factor for cardiovascular and renal diseases. Blood pressure increases progressively in a dose-dependent relationship with sodium chloride intake, demonstrated in clinical trials published over 25 years from 1976 through to 2001 for sodium intakes varying from 2,300 mg/day to 34,500 mg/day (NHMRC, 2005). People with hypertension, diabetes and chronic kidney disease, and older-age persons, tend to be more susceptible to increased blood pressure from sodium chloride intake (NHMRC, 2005) and are therefore likely to benefit by not consuming excessive dietary sodium (NRC, 1989).

Sodium is found in most foods as sodium chloride, commonly known as salt, which is added during processing. Salt accounts for about 90% of total sodium intake for countries like New Zealand and Australia (Fregly, 1984; Mattes and Donnelly, 1991). Sodium is also present in the diet as sodium bicarbonate, and in processed foods as monosodium glutamate, sodium phosphate, sodium carbonate, and sodium benzoate (NRC, 1989; NHMRC, 2005b).

The concentrations of sodium in individual foods of the 2003/04 NZTDS have previously been presented (Vannoort, 2003b, 2004 a,b,c). This data has been consolidated in an **Auxiliary Data** report**, Appendix 9.4** (Vannoort and Thomson, 2005), detailing the minimum, maximum and arithmetic mean concentrations of sodium for the foods analysed in the 2003/04 NZTDS.

The concentration of sodium in the 121 foods of the 2003/04 NZTDS ranged from <10 to 42,000 mg/kg, with the highest level measured in a yeast extract. Mean sodium concentrations varied markedly between and within food groups. The lowest sodium concentrations were generally in the fruit, vegetable and infant weaning food groups. It is also apparent that much higher sodium concentrations are found in processed compared with unprocessed foods. For example, tomatoes contained 36 mg/kg sodium, whereas tomato sauce contained 7,073 mg/kg. Similarly, pork chops contained 838 mg/kg sodium, while bacon contained 15,250 mg/kg; and cream (249 mg/kg), with cheese (6,304 mg/kg sodium).

Figure 28 Estimated dietary selenium intake in a 25+ year male in the 2003/04 NZTDS compared to overseas studies

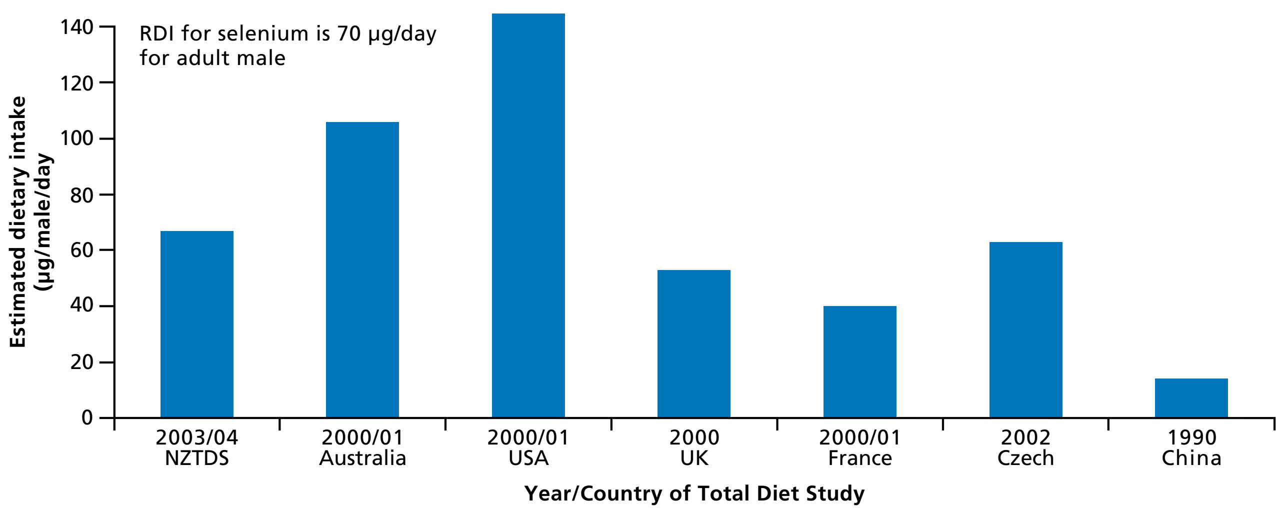


Table 23 Estimated mean dietary sodium intake (mg/day) for the eight age-sex groups of the 2003/04 NZTDS

Sodium intake (mg/day)	25+ yr Male	25+ yr Female	19-24 yr Young Male	11-14 yr Boy [d]	11-14 yr Girl [d]	5-6 yr Child [e]	1-3 yr Toddler	6-12 month Infant [f]
2003/04 NZTDS[a]	3047	2150	3603	3108	2496	2031	1384	845
AI[b] (mg/day)	460-920	460-920	460-920	400-800	400-800	300-600	200-400	170
UIL[c] (mg/day)	2300	2300	2300	2000	2000	1400	1000	unable to be set
Intake as % of UIL	**132%**	**93%**	**157%**	**155%**	**125%**	**145%**	**138%**	

a The intake for each age-sex group is based on assigning not detected results to half LOD (as explained in section 2.4)
b Acceptable Intake range (draft) (NHMRC, 2005)
c Upper Intake Limit (draft) (NHMRC, 2005)
d Nutrient reference values (NRV) for 11-14 year boy/girl extrapolated from values for 9-13 year children
e NRVs for 5-6 year child extrapolated from 4-8 year child
f NRVs for 6-12 month infant from 7-12 month infant

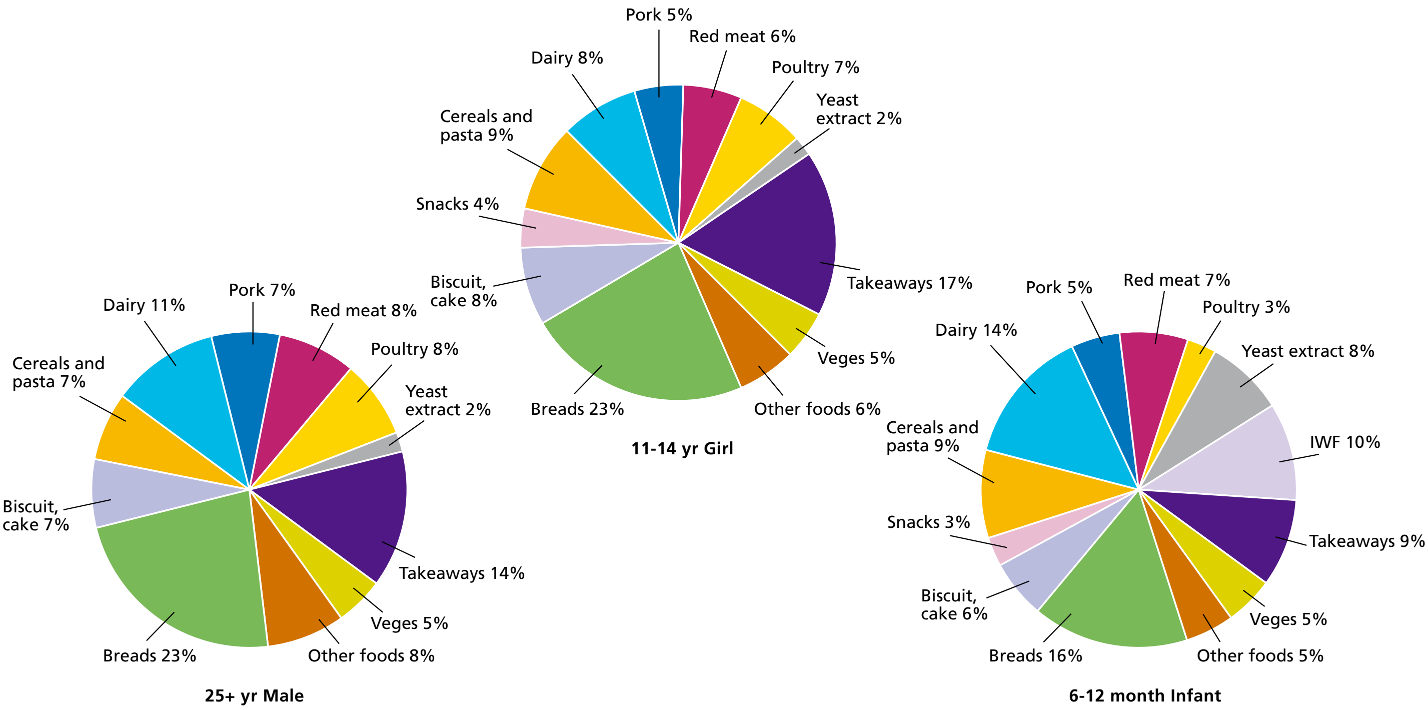
Intake estimates for the eight age-sex groups are shown in Table 23. Mean daily sodium intakes are significantly above the acceptable intake for all age-sex groups, and exceed the upper intake limits for 25+ year males and females, 19-24 year young males, and 11-14 year boys and girls by up to 125% for the average consumer. For a high consumer (95th percentile), intake of sodium could be approximately twice that of an average consumer (WHO, 1985), resulting in sodium intakes up to 6,200 mg/day for the 11-14 year boy, more than three times the upper intake limit.

The daily intake estimates in Table 23 include only sodium inherent in the food, and sodium added in processing, but not discretionary salt. Sodium inherent in foods has been estimated to contribute about 15%, and sodium from processing 65-70% of total sodium intake (Mattes and Donnelly, 1991; SACN, 2003). Discretionary salt added at the time of cooking or at the table has been estimated to account for 11-20% of total sodium intake (Mattes and Donnelly, 1991; IFST, 2003; UK SACN, 2003). Hence, if discretionary salt is included, sodium intake may be up to 20% higher than the values given in Table 23.

The upper intake limit (UIL) of 2,300 mg/day is based on population studies showing low levels of hypertension (less than 2%) in communities with sodium intakes below 1,600 mg/day, in addition to experimental studies that show a reduction in blood pressure at intakes of 1,500 mg/day compared with 2,500 mg/day (NHMRC, 2005). Cardiovascular disease (CVD) is a leading cause of death in New Zealand (MoH, 1999).

Figure 29 shows the distribution of foods contributing to sodium intake for an adult male, an adolescent girl and an infant, as representatives of the eight population groups. The single greatest contributor to sodium intake is bread, accounting for 15-27%, followed by processed meats (bacon, ham, corned beef and sausages), contributing 10-14% of total sodium intake. Grain products collectively account for 33-48% of sodium intake, similar to the estimate of 38% from the UK National Food Survey (UK SACN, 2003). Given that the majority of sodium intake is from processed foods, these are possible foods to target for sodium reduction.

Figure 29 Foods which contribute to estimated dietary sodium intake in a 25+ year male, 11-14 year girl and 6-12 month infant in the 2003/04 NZTDS



Key
IWF = Infant formulae & Weaning Foods

Table 24 Mean sodium concentration of foods (mg/kg) contributing more than 5% of total sodium intake for the 1987/88, 1990/91 and 2003/04 NZTDS

	1987/88 NZTDS	1990/91 NZTDS	2003/04 NZTDS
Bread, white	5815	5960	5063
Cheese	6880	6513	6304
Chicken	970	1018	3521
Ham	NA	NA	13275
Hamburger	NA	NA	4745
Meat pie	4462	3733	4599
Milk, 3.25% fat	760	520	383
Sausages	7635	7085	7352

NA = not analysed

Sodium concentrations in foods that contributed more than 5% to total sodium intake in the 2003/04 NZTDS for any of the age-sex population groups are shown in **Table 24**, with comparative concentration data from the 1987/88 (ESR/MoH, 1994) and 1990/91 NZTDS (Hannah et al., 1995).

The sodium concentration in white bread, cheese, sausages and meat pies has remained relatively stable over the 25 year period from 1987 to 2003, while the sodium content of whole milk appears to have dropped by 50%. The 360% increase in sodium content of chicken could be explained by the fact that 3/8 of the chicken samples analysed in 2003/04 were inadvertently sampled as either crumbed and stuffed, or marinated chicken, as opposed to raw chicken.

The trends for mean daily intake of sodium over the period from 1987 to 2003 are shown in **Figure 30**. Sodium intakes have decreased by 17, 14, and 8% for a young male, female, and toddler, respectively.

Figure 30 Trend of estimated mean daily sodium intake (mg/day) for a 19-24 year young male (YM), 25+ year female (F) and 1-3 year toddler (T) over previous NZTDSs

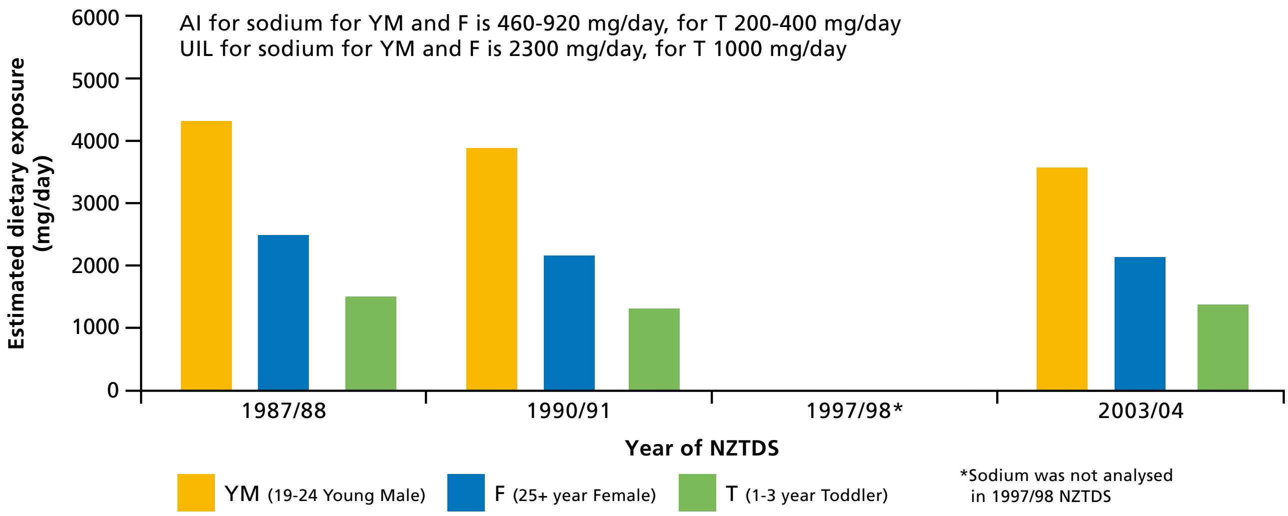


Table 25 Comparison of estimated daily dietary exposure to sodium for a 25+ year male and 25+ year female in the 2003/0 4 NZTDS with overseas studies

	2003/04 NZTDS [1]	USA[a]	UK[b]	France[c, 2]	Czech[d]
Adult or 25+ yr male	3047	2521	2570 (adult)	2200 (adult)	4550
Adult or 25+ yr female	2150	1762			2610

a 1991-96 data (Egan et al, 2002)
b IFST, 2003
c 2000/01 data (Leblanc et al, 2005)
d 2002 data (Ruprich, 2003)
1 Excludes table and cooking salt
2 Excludes table salt

Internationally, sodium intakes range from less than 200 mg/day for the Yanomamo Indians of Brazil, to over 10,300 mg/day in Northern Japan (Rose et al, 1988; NRC, 1989). The average sodium intake in the UK diet is 2,570 mg/day (excluding table salt) (IFST, 2003). The median intake of sodium from the first French TDS is 2,200 mg/kg for adults (men and women), and 1,700 mg/kg for children 3-11 years (Leblanc et al, 2005).

Sodium intakes from the 1991-1996 US TDS were estimated to be: men 2,304-2,739 mg/day, women 1,682-1,842 mg/day, children (10 years) 2,250 mg/day, children (6 years) 1,915 mg/day, toddlers (2 years) 1,289 mg/day, and infants (6-11 months) 288 mg/day (Egan et al, 2002). In the Czech Republic, sodium intake for males is 4,550 mg/day and for females, 2,610 mg/day (Ruprich, 2003). This comparative data for dietary sodium for 25+ year males and females from the 2003/04 NZTDS and overseas is summarized in **Table 25**.

5.4 Exposure Estimates for Nutrient Elements

The calculated dietary iodine intakes for all age-sex groups are well below recommended levels and are low compared with international intakes. For all age-sex groups, calculated iodine intakes were 57% or less of the RDI and have steadily decreased since 1982. It should be noted that the dietary iodine intakes calculated in each NZTDS are likely to be underestimated because discretionary iodised salt used during cooking or at the table was not included.

Calculated dietary intakes of iron are between the RDI and upper intake limit for a 25+ year male, 19-24 year young man, and 11-14 year boy and girl in New Zealand. However, despite the fortification of cereals, the average intake of iron in New Zealand for a 25+ year female is only about half the RDI. Calculated iron intakes for a 6-12 month infant and for children 1 to 6 years are also below the RDI.

Calculated daily dietary intakes of selenium for all age-sex groups of the 2003/04 NZTDS meet or are slightly below the RDI and are mid range between international intakes. Those living in the South Island and in low selenium areas are likely to have lower dietary intakes of selenium.

Mean daily sodium intakes exceed the adequate intake range for all age-sex groups and exceed the upper intake limit for a 25+ year male and female, 19-24 year young male, 11-14 year boy and girl, 5-6 year child, and 1-3 year toddler by 25-57%. For a high consumer, sodium intake may exceed the upper intake limit by a factor of three. None of these estimates include the use of discretionary salt that may also increase sodium intake by up to an additional 20%.

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Appendix 1: National (N) and Regional (R) Foods sampled in the 2003/04 NZTDS

2003/04 NZTDS Food	R/N	2003/04 NZTDS Food	R/N
Beverages, alcoholic		Fruit	
Beer	N	Apple	R
Wine, still red	N	Apple-based juice	N
Wine, still white	N	Apricot, canned	N
		Avocado	R
Beverages, non-alcoholic		Banana	R
Caffeinated beverage	N	Grapes	R
Carbonated drink	N	Kiwifruit	R
Chocolate beverage	N	Melons	R
Coffee beans, ground	R	Nectarine	R
Coffee, instant	N	Orange	N
Fruit drink	N	Orange juice	N
Tea	N	Peaches, canned	N
Water	R	Pear	R
		Pineapple, canned	N
Chicken, eggs, fish and meat		Prunes	N
Bacon	R	Raisins/sultanas	N
Beef, mince	R	Strawberries	R
Beef, rump	R		
Chicken	N	Grains	
Corned beef	R	Biscuit, chocolate	N
Egg	R	Biscuit, cracker	N
Fish fingers	N	Biscuits, plain sweet	N
Fish, canned	N	Bran flake cereal, mixed	N
Fish, fresh	R	Bread, mixed grain	R
Ham	R	Bread, wheatmeal	R
Lamb/mutton	R	Bread, white	R
Lambs liver	R	Cake	R
Mussels	R	Cornflakes	N
Oysters	R	Muesli	N
Pork chop	R	Muffin	R
Sausages	R	Noodles, instant	N
Soup, chicken	N	Oats, rolled	N
		Pasta, dried	N
Dairy products		Rice, white	N
Butter	R	Snacks, flavoured	N
Cheese	N	Spaghetti in sauce, canned	N
Cream	R	Wheat biscuit cereals	N
Dairy dessert	N		
Icecream	N	Infant weaning foods	
Milk, 0.5% fat	R	Infant & Follow on formula	N
Milk, 3.25% fat	R	Infant weaning food, cereal based	N
Milk, flavoured	R	Infant weaning food, custard/fruit	N
Yoghurt	N	Infant weaning food, savoury	N

continued…

2003/04 NZTDS Food	R/N	2003/04 NZTDS Food	R/N
Nuts		Vegetables	
Peanut butter	N	Beans	N
Peanuts, whole	N	Beans, baked, canned	N
		Beetroot, canned	N
Oils		Broccoli/cauliflower	R
Margarine	N	Cabbage	R
Oil	N	Capsicum	R
Salad dressing	N	Carrot	R
		Celery	R
Spreads and sweets		Corn, canned	N
Chocolate, plain milk	N	Courgette	R
Confectionery	N	Cucumber	R
Honey	N	Kumara	R
Jam	N	Lettuce	R
Snack bars	N	Mushrooms	R
Sugar	N	Onion	R
Yeast extract	N	Peas	N
		Potato crisps	N
Takeaways		Potatoes, peeled	R
Chicken takeaway	R	Potatoes, with skin	R
Chinese dish	R	Pumpkin	R
Fish, battered	R	Silverbeet	R
Hamburger, plain	R	Soy milk	N
Meat pie	R	Taro	R
Pizza	R	Tomato	R
Potato, hot chips	R	Tomato sauce	N
		Tomatoes in juice	N

Appendix 2: Summary of Estimated Dietary Exposures to Agricultural Compound Residues by Age-Sex Group and as a Percentage of Acceptable Daily Intake (ADI) in the 2003/04 NZTDS

Agricultural compound residue	ADI[a] (µg/kg bw/day)	Estimated dietary exposure for population age-sex group (µg/kg bw/day)							
		25+ yr Male	25+ yr Female	19-24 yr Male	11-14 yr Male	11-14 yr Female	5-6 yr Child	1-3 yr Toddler	6-12 mnth Infant
Acetochlor	12	0.00003	0.00002	0.00003	0.00010	0.00007	0.00021	0.00012	0.00000
%ADI		0.0002	0.0001	0.0003	0.0009	0.0006	0.0017	0.0010	0.0000
Azinphos-methyl	5	0.0003	0.0003	0.0003	0.0003	0.0003	0.0007	0.0009	0.0008
%ADI		0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
Azoxystrobin	30	0.0008	0.0010	0.0010	0.0010	0.0007	0.0023	0.0044	0.0052
%ADI		0.003	0.003	0.003	0.003	0.002	0.008	0.015	0.017
BHC-a	no	0.00002	0.00002	0.00003	0.00002	0.00002	0.00005	0.00000	0.00000
%ADI	ADI								
BHC-b	no	0.0001	0.0001	0.0001	0.0002	0.0001	0.0004	0.0002	0.0000
%ADI	ADI								
Bifenthrin	20	0.0004	0.0004	0.0005	0.0006	0.0005	0.0006	0.0008	0.0005
%ADI		0.002	0.002	0.003	0.003	0.002	0.003	0.004	0.002
Bromopropylate	30	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0004	0.0004
%ADI		0.0002	0.0003	0.0003	0.0005	0.0005	0.0004	0.0014	0.0014
Buprofezin	10	0.0005	0.0006	0.0002	0.0004	0.0005	0.0003	0.0005	0.0004
%ADI		0.005	0.006	0.002	0.004	0.005	0.003	0.005	0.004
Captan	100	0.058	0.071	0.035	0.043	0.075	0.090	0.141	0.121
%ADI		0.06	0.07	0.03	0.04	0.07	0.09	0.14	0.12
Carbaryl	8	0.056	0.067	0.030	0.046	0.053	0.154	0.211	0.339
%ADI		0.7	0.8	0.4	0.6	0.7	1.9	2.6	4.2
Chlorothalonil	30	0.0016	0.0022	0.0014	0.0030	0.0020	0.0021	0.0034	0.0007
%ADI		0.005	0.007	0.005	0.010	0.007	0.007	0.011	0.002
Chlorpropham	30	0.0076	0.0044	0.0147	0.0195	0.0158	0.0221	0.0247	0.0157
%ADI		0.03	0.01	0.05	0.06	0.05	0.07	0.08	0.05
Chlorpyriphos	10	0.0038	0.0035	0.0050	0.0051	0.0051	0.0116	0.0184	0.0186
%ADI		0.04	0.03	0.05	0.05	0.05	0.12	0.18	0.19
Chlorpyriphos-methyl	10	0.0472	0.0442	0.0421	0.0765	0.0625	0.1297	0.1301	0.1083
%ADI		0.47	0.44	0.42	0.77	0.63	1.30	1.30	1.08
Cyhalothrin, total	2	0.0002	0.0002	0.0002	0.0003	0.0003	0.0005	0.0028	0.0027
%ADI		0.01	0.01	0.01	0.01	0.01	0.03	0.14	0.13
Cypermethrin	50	0.0017	0.0014	0.0014	0.0025	0.0025	0.0040	0.0183	0.0174
%ADI		0.003	0.003	0.003	0.005	0.005	0.008	0.037	0.035
Cyproconazole	4	0.00004	0.00005	0.00006	0.00009	0.00009	0.00008	0.00028	0.00027
%ADI		0.001	0.001	0.002	0.002	0.002	0.002	0.007	0.007
Cyprodinil	27	0.0022	0.0026	0.0016	0.0020	0.0024	0.0061	0.0125	0.0110
%ADI		0.01	0.01	0.01	0.01	0.01	0.02	0.05	0.04
DDT, total	10	0.0216	0.0170	0.0259	0.0267	0.0194	0.0370	0.0511	0.0425
%ADI		0.22	0.17	0.26	0.27	0.19	0.37	0.51	0.43
Diazinon	2	0.0015	0.0018	0.0015	0.0029	0.0022	0.0040	0.0039	0.0021
%ADI		0.07	0.09	0.08	0.15	0.11	0.20	0.20	0.10
Dichlofluanid	300	0.0075	0.0095	0.0089	0.0052	0.0062	0.0099	0.0128	0.0107
%ADI		0.003	0.003	0.003	0.002	0.002	0.003	0.004	0.004
Dichlorvos	4	0.0001	0.0001	0.0002	0.0008	0.0006	0.0012	0.0012	0.0007
%ADI		0.004	0.003	0.004	0.019	0.015	0.029	0.030	0.017
Dicloran	10	0.0040	0.0047	0.0021	0.0023	0.0053	0.0036	0.0096	0.0138
%ADI		0.04	0.05	0.02	0.02	0.05	0.04	0.096	0.14
Dicofol	2	0.0021	0.0020	0.0017	0.0017	0.0017	0.0033	0.0157	0.0140
%ADI		0.10	0.10	0.08	0.09	0.08	0.16	0.78	0.70
Dieldrin	0.1	0.0015	0.0012	0.0008	0.0008	0.0006	0.0012	0.0036	0.0043
%ADI		1.5	1.2	0.8	0.8	0.6	1.2	3.6	4.3
Difenoconazole, total	10	0.0008	0.0010	0.0009	0.0012	0.0007	0.0011	0.0018	0.0009
%ADI		0.008	0.010	0.009	0.012	0.007	0.011	0.018	0.009

Agricultural compound residue	ADI[a] (µg/kg bw/day)	Estimated dietary exposure for population age-sex group (µg/kg bw/day)							
		25+ yr Male	25+ yr Female	19-24 yr Male	11-14 yr Male	11-14 yr Female	5-6 yr Child	1-3 yr Toddler	6-12 mnth Infant
Diflufenican	200*	0.0003	0.0002	0.0003	0.0002	0.0001	0.0002	0.0003	0.0001
%ADI		0.0001	0.0001	0.0002	0.0001	0.0001	0.0001	0.0002	0.0001
Dimethoate	2	0.0310	0.0375	0.0262	0.0465	0.0266	0.0475	0.0584	0.0781
%ADI		1.6	1.9	1.3	2.3	1.3	2.4	2.9	3.9
Diphenylamine	80	0.0860	0.1171	0.1076	0.1243	0.1398	0.2993	0.2988	0.2933
%ADI		0.11	0.15	0.13	0.16	0.17	0.37	0.37	0.37
Dithiocarbamates	3 - 30	0.204	0.237	0.169	0.215	0.180	0.352	0.441	0.555
%ADI		0.7- 6.8	0.8 - 7.9	0.6 - 5.6	0.7 - 7.2	0.6 - 6.0	1.2 - 11.7	1.5 - 14.7	1.9 - 18.5
Endosulfan, total	6	0.0375	0.0404	0.0228	0.0328	0.0343	0.0289	0.0391	0.0296
%ADI		0.63	0.67	0.38	0.55	0.57	0.48	0.65	0.49
Ethoxyquin	5	0.0305	0.0247	0.0303	0.0402	0.0220	0.0390	0.0445	0.0332
%ADI		0.6	0.5	0.6	0.8	0.4	0.8	0.9	0.7
Fenitrothion	5	0.0868	0.0733	0.0796	0.1297	0.0963	0.2028	0.1833	0.1644
%ADI		1.7	1.5	1.6	2.6	1.9	4.1	3.7	3.3
Fenpropathrin	30	0.0002	0.0002	0.0001	0.0002	0.0002	0.0005	0.0030	0.0028
%ADI		0.001	0.001	0.000	0.001	0.001	0.002	0.010	0.009
Fenvalerate	20	0.0004	0.0003	0.0003	0.0003	0.0003	0.0008	0.0034	0.0032
%ADI		0.002	0.002	0.001	0.002	0.002	0.004	0.017	0.016
Fludioxinil	40	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	0.0002
%ADI		0.0003	0.0003	0.0002	0.0002	0.0002	0.0006	0.0006	0.0005
Indoxacarb	20	0.0017	0.0021	0.0015	0.0028	0.0029	0.0066	0.0049	0.0051
%ADI		0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.03
Iprodione	60	0.1753	0.2280	0.1078	0.1238	0.1321	0.3610	0.4031	0.6358
%ADI		0.3	0.4	0.2	0.2	0.2	0.6	0.7	1.1
Kresoxim-methyl	400	0.00003	0.00004	0.00002	0.00002	0.00003	0.00009	0.00008	0.00006
%ADI		0.00001	0.00001	0.00001	0.00000	0.00001	0.00002	0.00002	0.00001
Linuron	10*	0.0010	0.0009	0.0009	0.0010	0.0008	0.0020	0.0025	0.0022
%ADI		0.0098	0.0095	0.0088	0.0096	0.0079	0.0196	0.0253	0.0222
Malathion	300	0.0023	0.0024	0.0021	0.0037	0.0032	0.0068	0.0148	0.0105
%ADI		0.0008	0.0008	0.0007	0.0012	0.0011	0.0023	0.0049	0.0035
Metalaxyl	80	0.0011	0.0016	0.0008	0.0013	0.0010	0.0011	0.0019	0.0024
%ADI		0.001	0.002	0.001	0.002	0.001	0.001	0.002	0.003
Parathion-methyl	3	0.0002	0.0001	0.0001	0.0002	0.0002	0.0004	0.0025	0.0024
%ADI		0.007	0.005	0.004	0.006	0.006	0.014	0.085	0.080
Penconazole	30	0.00003	0.00006	0.00004	0.00005	0.00003	0.00005	0.00008	0.00012
%ADI		0.0001	0.0002	0.0001	0.0002	0.0001	0.0002	0.0003	0.0004
Pencycuron	20*	0.0020	0.0012	0.0013	0.0016	0.0014	0.0027	0.0021	0.0019
%ADI		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Permethrin, total	50	0.0057	0.0058	0.0038	0.0054	0.0052	0.0048	0.0075	0.0061
%ADI		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Phorate, total	0.7	0.0037	0.0037	0.0040	0.0052	0.0042	0.0094	0.0087	0.0078
%ADI		0.5	0.5	0.6	0.7	0.6	1.3	1.2	1.1
Phosmet	10	0.0194	0.0255	0.0073	0.0118	0.0105	0.0354	0.0146	0.0352
%ADI		0.1940	0.2554	0.0731	0.1181	0.1047	0.3537	0.1463	0.3522
Piperonyl butoxide	200	0.0097	0.0091	0.0081	0.0127	0.0118	0.0232	0.0440	0.0403
%ADI		0.0048	0.0046	0.0041	0.0063	0.0059	0.0116	0.0220	0.0202
Pirimicarb	20	0.0266	0.0285	0.0252	0.0350	0.0235	0.0131	0.0120	0.0012
%ADI		0.133	0.142	0.126	0.175	0.117	0.066	0.060	0.006
Pirimiphos-methyl	30	0.2368	0.2131	0.2261	0.4049	0.3160	0.6676	0.6521	0.5034
%ADI		0.8	0.7	0.8	1.3	1.1	2.2	2.2	1.7
Procymidone	100	0.0179	0.0182	0.0155	0.0193	0.0161	0.0299	0.0642	0.0643
%ADI		0.018	0.018	0.016	0.019	0.016	0.030	0.064	0.064

Appendix 2: Summary of Estimated Dietary Exposures to Agricultural Compound Residues by Age-Sex Group and as a Percentage of Acceptable Daily Intake (ADI) in the 2003/04 NZTDS

Agricultural compound residue	ADI[a] (µg/kg bw/day)	Estimated dietary exposure for population age-sex group (µg/kg bw/day)							
		25+ yr Male	25+ yr Female	19-24 yr Male	11-14 yr Male	11-14 yr Female	5-6 yr Child	1-3 yr Toddler	6-12 mnth Infant
Propargite 1+2	10	0.0043	0.0037	0.0027	0.0038	0.0041	0.0086	0.0370	0.0352
%ADI		0.04	0.04	0.03	0.04	0.04	0.09	0.37	0.35
Propazine	20*	0.000039	0.000062	0.000041	0.000100	0.000059	0.000069	0.000124	0.000000
%ADI		0.0002	0.0003	0.0002	0.0005	0.0003	0.0003	0.0006	0.0000
Propham	no	0.2372	0.1763	0.2565	0.3785	0.3276	0.5678	0.3633	0.3067
%ADI	ADI								
Propiconazole, total	70	0.0003	0.0003	0.0002	0.0003	0.0004	0.0012	0.0021	0.0034
%ADI		0.0004	0.0005	0.0003	0.0004	0.0005	0.0017	0.0030	0.0049
Propoxur	20	0.0006	0.0003	0.0017	0.0010	0.0009	0.0013	0.0011	0.0008
%ADI		0.003	0.001	0.008	0.005	0.004	0.007	0.005	0.004
Prothiophos	0.1	0.00003	0.00004	0.00002	0.00002	0.00003	0.00009	0.00008	0.00006
%ADI		0.03	0.04	0.02	0.02	0.03	0.09	0.08	0.06
Pyrazophos	4	0.00001	0.00002	0.00001	0.00001	0.00001	0.00001	0.00002	0.00003
%ADI		0.00019	0.00039	0.00023	0.00033	0.00016	0.00029	0.00052	0.00074
Pyrimethanil	100	0.0332	0.0446	0.0243	0.0018	0.0038	0.0031	0.0072	0.0051
%ADI		0.017	0.022	0.012	0.001	0.002	0.002	0.004	0.003
Quintozene	10	0.00005	0.00005	0.00006	0.00051	0.00052	0.00094	0.00090	0.00072
%ADI		0.001	0.001	0.001	0.005	0.005	0.009	0.009	0.007
Sethoxydim	180*	0.0002	0.0003	0.0008	0.0011	0.0007	0.0012	0.0025	0.0018
%ADI		0.0001	0.0002	0.0005	0.0006	0.0004	0.0007	0.0014	0.0010
Simazine	5*	0.0059	0.0042	0.0074	0.0042	0.0029	0.0046	0.0072	0.0030
%ADI		0.12	0.08	0.15	0.08	0.06	0.09	0.14	0.06
Tebuconazole	30	0.00033	0.00052	0.00025	0.00011	0.00016	0.00051	0.00045	0.00033
%ADI		0.001	0.002	0.001	0.000	0.001	0.002	0.002	0.001
Tebufenpyrad	2*	0.00014	0.00021	0.00011	0.00011	0.00016	0.00051	0.00045	0.00033
%ADI		0.007	0.011	0.006	0.005	0.008	0.025	0.023	0.016
Terbufos	0.2	0.0007	0.0005	0.0009	0.0005	0.0004	0.0006	0.0009	0.0004
%ADI		0.36	0.26	0.46	0.26	0.18	0.28	0.44	0.18
Terbutylazine	3*	0.0023	0.0016	0.0028	0.0016	0.0011	0.0018	0.0028	0.0012
%ADI		0.08	0.05	0.09	0.05	0.04	0.06	0.09	0.04
Tetrachlorvinphos	50*	0.0024	0.0021	0.0027	0.0034	0.0023	0.0069	0.0211	0.0086
%ADI		0.005	0.004	0.005	0.007	0.005	0.014	0.042	0.017
Tolylfluanid	80	0.0313	0.0396	0.0202	0.0226	0.0439	0.0428	0.0826	0.0644
%ADI		0.04	0.05	0.03	0.03	0.05	0.05	0.10	0.08
Triademefon	30	0.00002	0.00003	0.00001	0.00001	0.00002	0.00006	0.00005	0.00004
%ADI		0.00006	0.00009	0.00005	0.00004	0.00007	0.00020	0.00018	0.00013
Triademenol	50	0.00009	0.00015	0.00008	0.00009	0.00010	0.00027	0.00027	0.00024
%ADI		0.00018	0.00029	0.00016	0.00018	0.00019	0.00054	0.00055	0.00049
Trifloxystrobin	40	0.0002	0.0002	0.0001	0.0003	0.0003	0.0008	0.0005	0.0005
%ADI		0.0005	0.0005	0.0003	0.0008	0.0008	0.0020	0.0012	0.0013
Vinclozolin	10	0.0001	0.0003	0.0001	0.0001	0.0002	0.0008	0.0009	0.0004
%ADI		0.001	0.003	0.001	0.001	0.002	0.008	0.009	0.004

a ADIs are those established by JMPR (IPCS, 2002)
* New Zealand ADIs established by Environmental Risk Management Agency

Appendix 3: Agricultural compound residues not detected in the 2003/04 NZTDS

Acephate
Alachlor
Aldrin
Atrazine
Azaconazole
Benalaxyl
Bendiocarb
Benodanyl
Bentazone
Binapacryl
Bitertanol
Bromacil
Bromoxynil
Bromophos-ethyl
Bromophos(-methyl)
Bupirimate
Carbofuran
Carboxin
Chlordane-cis
Chlordane-trans
Chlorfenvinphos
Chlorfluazuron
Chlornitrofen
Chlorobenzilate
Chlorsulphuron
Chlorthal-dimethyl
Chlozolinate
Clomazone
Clopyralid
Coumaphos
Cyanazine
Cyfluthrin
Cymoxanil
2,4-D
2,4′ DB
2,4′ DDE
2,4′ DDT
4,4′ DDT
Deltamethrin
Demeton-s-methyl
Dicamba
Dichlobenil
Dichlofenthion
Dichlorprop
Dicrotophos
Dimethenamid
Dimethomorph
Diphenamid
Disulfoton
Endrin
EPN
Epoxiconazole
EPTC
Esfenvalerate
Ethiofencarb
Ethion
Etridiazole
Etrimphos
Famphur
Fenarimol
Fenchlorphos
Fenoxycarb
Fenpiclonil
Fenpropimorph
Fensulfothion
Fenthion
Fipronil
Flamprop-methyl
Fluazifop-butyl
Fluazinam
Fluometuron
Flusilasole
Flutriafol
Fluvalinate-DL
Fluvalinate-D
Folpet
Furalaxyl
Furathiocarb
Halxyfop-methyl
HCB
Heptachlor
Heptachlor endo epoxide
Heptachlor exo epoxide
Heptenophos
Hexaconazole
Hexazinone
Iodophenphos
Isazophos
Isofenphos
Isoproturon
Lindane
MCPA
MCPB
Mecoprop -P
Metamitron
Metsulfuron
Methacrifos
Methidathion
Methiocarb
Metolachlor
Metribuzin
Mevinphos
Monocrotophos
Napropamide
Nitrofen
Nitrothal-isopropyl
Norflurazon
Oxadiazon
Oxadixyl
Oxyfluorfen
Paclobutrazol
Parathion(-ethyl)
Pendimethalin
Phosalone
Phosphamidon-a
Phosphamidon-b
Picloram
Prochloraz
Prometryn
Propachlor
Propetamphos
Propyzamide
Pyriproxyfen
Quizalofop-ethyl
2,4,5 T
Terbacil
Terbumeton
Terbutryn
Tetradifon
Thiometon
Tolclofos-methyl
Tralkoxydim
Triallate
Triaulfuron
Triazophos
Triclopyr
Trifluralin

Appendix 4: Foods in which no Agricultural Compounds were detected in the 2003/04 NZTDS

Beer

Beetroot, canned

Carbonated drink

Chocolate beverage

Coffee beans, ground

Coffee, instant

Confectionery

Cornflakes

Fruit drink

Infant & Follow on formula

Infant weaning food, savoury

Lambs liver

Margarine

Milk, 0.5% fat

Mussels

Oranges

Orange juice

Oysters

Pineapple, canned

Soup, chicken

Spaghetti in sauce, canned

Sugar

Tea

Water

Yeast extract

Appendix 5: Glossary of Terms, Abbreviations and Acronyms

ADI
Acceptable Daily Intake is the daily intake of a chemical which, during the entire life-time of the consumer, appears to be without appreciable risk to health. This is derived from all known toxicological data at the time of the evaluation of the chemical (for pesticides - internationally by the Joint FAO/WHO Meeting on Pesticide Residues, JMPR). The JMPR sets WHO ADIs, which are normally adopted by New Zealand.

Agricultural compound*
for the purposes of this survey, is a generic term for any substance intended for preventing, destroying, attracting, repelling or controlling any pest, including unwanted species of plants or animals during the production, storage, transportation, distribution and processing of food, agricultural commodities or animal feed. The term includes pesticides, fungicides, insecticides, herbicides and chemicals which may be administered to animals for the control of ectoparasites. It includes substances applied to crops either before or after harvest to protect the commodity from deterioration during storage and transportation, or disinfestations of raw primary produce.

Agricultural compound residue*
is any specified substance in food, agricultural commodities, or animal feed resulting from the use of an agricultural compound (from known, unknown or unavoidable sources). Includes any derivatives of an agricultural compound, such as conversion products, metabolites, reaction products and impurities considered to be of toxicological significance.

AI
Adequate Intake – where an RDI for a nutrient cannot be determined because of limited or inconsistent data, then an Adequate Intake (AI) is determined. The AI can be used as a goal for individual intake but is based on experimentally derived intake levels or approximations of observed mean nutrient intakes by a group of apparently healthy people maintaining a defined nutritional state (NHMRC, 2005).

ATDS Australian Total Diet Study

Analyte a substance detected by chemical analyses.

Arithmetic mean
simple average calculated by summing all values in the data set and dividing by the number of values in the data set.

* NB in previous NZTDSs, the term used for these compounds was pesticides

B Boy, 11-14 years, 54 kg bw, 10.4 MJ/day diet

bw body weight

C Child, 5-6 years, 23 kg bw, 7.2 MJ/day diet

Composite
a sample produced by combining portions of each of a number of constituent samples. In this report, composite refers to the product of equal portions of constituent samples.

dL decilitre

DTC Dithiocarbamate

ESR Institute of Environmental Science & Research Limited

F Female, 25+ years, 70 kg bw, 8.2 MJ/day diet

FAO Food and Agriculture Organization

G Girl, 11-14 years, 55 kg bw, 8.5 MJ/day diet

g grams

GAP Good agricultural practice

GEMS Global Environmental Monitoring System

HPOs Health Protection Officers

I Infant, 6-12 months, 9 kg bw, 3.8 MJ/day diet

IPCS International Programme on Chemical Safety

JECFA the Joint FAO/WHO Expert Committee on Food Additives

JMPR the Joint FAO/WHO Meeting on Pesticide Residues

kg kilograms

LOD
Limit of Detection is defined as the minimum concentration of the analyte in a dietary sample that can just be detected under a pre-established set of analysis conditions. LOD can be calculated from 3 times standard deviation (SD) of the blank; the LOD in food must be corrected for weight of food sampled and final volume of digest (Keith et al, 1983). For the purposes of the 2003/04 NZTDS, concentrations above the LOD have been reported and used in determining mean concentrations, which are then used for dietary exposure estimates.

LOQ
Limit of Quantitation is the minimum concentration of analyte in a dietary sample that can be determined quantitatively with acceptable accuracy and consistency. The limit of quantitation is also referred to as the 'limit of reporting' in the international literature (FAO/UNEP/WHO, 1985). LOQ can be calculated from 10 times standard deviation (SD) of the blank; the LOQ in food items must be corrected for the weight of food sampled and final volume of digest (Keith et al, 1983). The LOQ is also referred to as the 'limit of reporting' (LOR) in the international literature.

Lower bound intake estimate (LB)
Dietary intakes are estimates obtained by multiplying the mean concentration of the analyte in a food by the amount of each food consumed. The intake from each food is then summed across all foods in the diet to yield a total dietary intake. A problem arises when the concentration of analyte in the food is 'not detected', what concentration value should be assigned to it? The true concentration could be anywhere from zero, up to the limit of detection (LOD). For nutrients in New Zealand, such as iodine and selenium, insufficiency of intake is likely to be more of a health issue than excessive intake. In this regard, intake calculations have also been undertaken which assign the value of zero to 'not detected' concentration data, and these thus provide a lower bound (LB) intake estimate.

M Male, 25+ years, 82 kg bw, 11.9 MJ/day diet

MAFF Ministry of Agriculture, Fisheries and Food (United Kingdom)

MeHg methylmercury

mg/kg milligrams per kilogram, equivalent to ppm

μg/kg micrograms per kilogram, equivalent to ppb

MJ megajoule

mls millilitres

MoH Ministry of Health (New Zealand)

Na Sodium

NNS National Nutrition Survey of New Zealand, undertaken in 1997

Not detected
means the analytical result is below the limit of detection (LOD)

NRC National Research Council (United States)

NRV Nutrient Reference Value of Australia and New Zealand (NHMRC, 2005)

NZTDS New Zealand Total Diet Survey

50th percentile
the 50th percentile corresponds to the value that divides a set of ordered results into two halves. It is also known as the median.

90th percentile
the 90th percentile corresponds to the value that has 90% of ordered results below it. It only has 10% of results above it.

ppb parts per billion

PTWI
Provisional Tolerable Weekly Intake is the end-point used by JECFA for food contaminants such as heavy metals with cumulative properties. Its value represents permissible human weekly exposure to those contaminants unavoidably associated with consumption of otherwise wholesome and nutritious foods (WHO, 1987c).

Q1, Q2, etc
Quarter 1, quarter 2 etc. Sampling periods for the 2003/04 NZTDS

RDIs
Recommended Dietary Intakes are the levels of intake of essential nutrients that, on the basis of scientific knowledge, are considered by an expert working party to be sufficient to meet the nutrient requirements of nearly all (97-98%) healthy individuals in a life stage/gender group (NHMRC, 2005).

T Toddler, 1-3 years, 13 kg bw, 5.2 MJ/day diet

TDS Total Diet Study

UIL
Upper Intake limit – the highest level of continuing daily nutrient intake likely to pose no adverse health effects in almost all individuals (NHMRC, 2005).

UK DoH United Kingdom Department of Health

US EPA United States Environmental Protection Agency

US FDA United States Food and Drug Administration

Upper bound intake estimate (UB)
Dietary intakes are estimates obtained by multiplying the mean concentration of the analyte in a food by the amount of each food consumed. The intake from each food is then summed across all foods in the diet to yield a total dietary intake. A problem arises when the concentration of analyte in the food is 'not detected', what concentration value should be assigned to it? The true concentration could be anywhere from zero up to the limit of detection (LOD). From a toxicological point of view, it is best to err on the side of caution, and this is achieved by assigning all 'not detected' results an upper bound value equal to the limit of detection. Such intakes are thus called upper bound (UB) intake estimates.

WHO World Health Organization

YM Young male, 19-24 years, 78 kg bw, 13.8 MJ/day diet

yr year

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AUXILIARY DATA

2003/04 New Zealand Total Diet Survey

Agricultural Compound Residues, Selected Contaminants and Nutrients

NEW ZEALAND FOOD SAFETY AUTHORITY

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INTRODUCTION

The 2003/04 New Zealand Total Diet Survey (NZTDS) was carried out for the New Zealand Food Safety Authority (NZFSA) by the Institute of Environmental Science & Research Limited (ESR). Results of the survey have been published elsewhere (Vannoort and Thomson, 2005). This document provides auxiliary information and data not included in the main report. Separate reports have also been produced detailing the 2003/04 NZTDS food list (Brinsdon, 2003) and the simulated typical diets (Brinsdon, 2004). All analytical data associated with the 2003/04 NZTDS have been released in four quarterly reports (Vannoort, 2003a; 2004a; 2004b; 2004c).

The 2003/04 NZTDS is the sixth such survey. A total of 121 foods were sampled. Foods were classified as national or regional, depending on whether they would be expected to have regional variability in agricultural compound, contaminant or nutrient level. National foods were purchased in Christchurch and regional foods were purchased from four different geographic regions. National and regional sampling was also carried out from each location on more than one occasion to take into account any seasonal variation in the foods. Details of the sampling protocol are available elsewhere (Vannoort, 2003b).

Foods were analysed for over 200 agricultural compounds; the four contaminant elements arsenic, cadmium, lead and mercury, and the four nutrient elements iodine, iron, selenium and sodium.

Exposures were estimated for eight age-gender groups: 25+ year male (M); 25+ year female (F); 19-24 year young male (YM); 11-14 year boy (B); 11-14 year girl (G); 5-6 year child (C); 1-3 year toddler (T); and 6-12 month infant (I).

APPENDIX 1: PREPARATION INSTRUCTIONS FOR FOODS SAMPLED IN THE 2003/04 NZTDS

Glossary of terms

In order for foods to be prepared in a consistent and unambiguous manner, terms used in this section have been clearly defined.

Chop

Samples are put into the appropriate sized food processor and chopped until a homogeneous mixture is attained – usually 6-8 minutes depending on the moisture content of the sample.

Blend

Samples are put into the appropriate sized blender (depending on the amount of the item being prepared) and blended until a homogeneous mixture is obtained – usually 2-4 minutes depending on the moisture content of the sample.

Combine

Units of the same sample are combined before chopping or blending. Regional or brand samples are kept separate.

Mix

When the preparation instructions state 'mix' or 'mix thoroughly' then the following procedures are to be followed:

For dry foods (such as flour) or semi-dry foods (such as cooked chopped meat):

- form the food into a cone or pile
- flatten the cone slightly and separate into four equal segments
- pull the segments apart so that four separate piles are formed
- combine diagonally opposite piles and mix together thoroughly
- this process should be repeated until thorough mixing of the foods has been achieved.

For foods containing juice (eg. nectarines)

- if possible, the food being prepared should be chopped in a large glass or stainless steel bowl so that all the juice is collected
- mixing of the chopped pieces is then carried out in the bowl using gloved hands or stainless steel cutlery. It should be mixed as thoroughly as possible
- unless cooking instructions state that the food must be drained, any juice must be regarded as an integral part of the food being prepared for analysis. A proportional amount of juice and seeds must be included in all sample containers.

For liquid samples (eg. oils and beer)

- liquids are to be measured into a large receptacle, such as a bowl or jug made of stainless steel or Pyrex. Plastic containers are to be avoided
- the total volume added to the receptacle should be thoroughly stirred with a stainless steel utensil before being poured into the sample containers.

Composite

Compositing involves thorough mixing/ blending/chopping of equal weights of the indicated samples.

Food preparation equipment

Selection of appropriate food preparation equipment is a vital component of the contamination control procedures.

Gloves

Gloves are to be worn whenever the food being prepared could come into contact with hands. Non-lubricated surgical-style gloves should be used.

Utensils

- stainless steel knives
- wooden (good quality, smooth, crack free) or glass chopping boards
- stainless steel or teflon-coated utensils. Glass equipment can also be used provided it is Pyrex
- large stainless steel or Pyrex receptacle (jug or bowl) for mixing liquids.

Ceramic and enamel ware should be avoided at all times, as these may leach traces of lead or cadmium.

Equipment

- domestic oven, with hotplates (electric)
- blenders, glass with stainless steel blades
- food processors, high density plastic with stainless steel blades
- frying-pans (Teflon-coated)
- large stainless steel pots.

Food preparation procedures

A key feature of a Total Diet Survey is that foods are prepared as for normal consumption. The following table summarises the procedures used to prepare food samples received by the food preparation laboratory. Foods are sorted alphabetically. Full details of food preparation methods are contained in the 2003/04 NZTDS Procedures Manual (Vannoort, 2003b). All water used in food preparation was distilled.

2003/04 NZTDS FOOD	FOOD PREPARATION METHOD
Apple	Rinsed, cored, chopped, not peeled
Apple-based juice	Mixed
Apricot, canned	Mixed and chopped without juice
Avocado	Flesh chopped
Banana	Skin discarded, chopped
Beans	Boiled until cooked, drained, mixed and chopped
Beans, baked, canned	Mixed and chopped
Beef, mince	Fried, without added fat, until cooked, mixed and chopped
Beef, rump	Fat trimmed, then fried until cooked and chopped
Beer	Mixed
Beetroot, canned	Mixed and chopped
Biscuit, chocolate	Mixed and chopped
Biscuit, cracker	Mixed and chopped
Biscuits, plain sweet	Mixed and chopped
Bran flake cereal, mixed	Mixed and chopped
Bread, mixed grain	Mixed and chopped
Bread, wheatmeal	Mixed and chopped
Bread, white	Mixed and chopped
Broccoli/cauliflower	Florets rinsed, boiled, drained, mixed and chopped
Butter	Chopped and mixed
Cabbage	Outer leaves discarded, rinsed, combined and chopped
Caffeinated beverage	Mixed
Cake	Mixed and chopped
Capsicum	Stem and seeds discarded, rinsed and chopped
Carbonated drink	Mixed
Carrot	Peeled, rinsed, chopped
Celery	Leaves discarded and stems trimmed, then rinsed and chopped
Cheese	Chopped and mixed
Chicken	Fried until cooked, mixed and chopped

2003/04 NZTDS FOOD	FOOD PREPARATION METHOD
Chicken takeaway	Combined and chopped
Chinese dish	Mixed and chopped
Chocolate beverage	Prepared as per label instructions and mixed
Chocolate, plain milk	Mixed and chopped
Coffee beans, ground	Prepared in boiling water, cooled and combined
Coffee, instant	Prepared in boiling water, cooled and combined
Confectionery	Melted in an equal weight of boiling water
Corn, canned	Drained and chopped
Corned beef	Mixed and chopped
Cornflakes	Mixed and chopped
Courgette	Ends discarded, remainder rinsed and chopped
Cream	Mixed
Cucumber	Ends discarded, remainder rinsed and chopped
Dairy dessert	Mixed
Egg	Boiled, peeled and chopped
Fish fingers	Oven cooked to label instructions, combined and chopped
Fish, battered	Combined and chopped
Fish, canned	Brine or oil drained and discarded, mixed and chopped
Fish, fresh	Grilled until cooked, combined and chopped
Fruit drink	Prepared as per label instructions and mixed
Grapes	Stalks removed, rinsed and chopped
Ham	Mixed and chopped
Hamburger, plain	Combined and chopped
Honey	Mixed
Ice-cream	Mixed
Infant & Follow on formula	Prepared as per label instructions if necessary, with water and mixed
Infant weaning food, cereal based	Prepared as per label instructions if necessary, with water and mixed
Infant weaning food, custard/fruit dish	Prepared as per label instructions if necessary, with water and mixed
Infant weaning food, savoury	Prepared as per label instructions if necessary, with water and mixed
Jam	Mixed
Kiwifruit	Skin discarded, flesh mixed and chopped
Kumara	Peeled, rinsed, boiled and chopped
Lamb/mutton	Fried until cooked, combined and chopped
Lambs liver	Sliced and fried until cooked, combined and chopped
Lettuce	Inner leaves rinsed and chopped
Margarine	Mixed
Meat pie	Chopped and mixed
Melons	Rind and seeds discarded, flesh chopped
Milk, 0.5% fat	Mixed
Milk, 3.25% fat	Mixed
Milk, flavoured	Mixed
Muesli	Mixed and chopped
Muffin	Mixed and chopped
Mushrooms	Rinsed and chopped
Mussels	Flesh mixed and chopped
Nectarine	Stone discarded, flesh chopped
Noodles, instant	Cooked according to label instructions, flavour sachet added, mixed and chopped
Oats, rolled	Cooked in water, then mixed
Oil	Mixed
Onion	Peeled, sliced, fried and chopped

2003/04 NZTDS FOOD	FOOD PREPARATION METHOD
Orange	Skins and seeds discarded, flesh chopped
Orange juice	Mixed
Oysters	Flesh mixed and chopped
Pasta, dried	Boiled in unsalted water until cooked. Mixed and chopped
Peaches, canned	Drained, combined and chopped
Peanut butter	Mixed
Peanuts, whole	Mixed and chopped
Pear	Core removed, chopped, not peeled
Peas	Boiled, mixed and chopped
Pineapple, canned	Drained, combined and chopped
Pizza	Cooked as per label instructions, combined and chopped
Pork chop	Flesh removed from bone, dry fried until cooked, mixed and chopped
Potato crisps	Mixed and chopped
Potato, hot chips	Mixed and chopped
Potatoes, peeled	Peeled, rinsed, boiled until cooked, drained and chopped
Potatoes, with skin	Scrubbed, cooked in microwave and chopped
Prunes	Mixed and chopped, with added water if necessary
Pumpkin	Cut into pieces, peeled, rinsed, boiled, drained and chopped
Raisins/sultanas	Mixed with an equal volume of water, chopped
Rice, white	Boiled in unsalted water until cooked. Mixed and chopped.
Salad dressing	Mixed
Sausages	Pre-cooked in boiling water and then fried until cooked. Combined and chopped
Silverbeet	Trim stems, wash, slice, boil, drain and chop
Snack bars	Combined and chopped
Snacks, flavoured	Mixed and chopped
Soup, chicken	Can contents or reconstituted sachet simmered for 5 minutes and mixed
Soy milk	Mixed
Spaghetti in sauce, canned	Mixed and chopped
Strawberries	Chopped
Sugar	Mixed
Taro	Peeled, rinsed, boiled, drained and homogenised
Tea	Brewed with boiling water, cooled and combined
Tomato	Rinsed, combined, chopped
Tomato sauce	Mixed
Tomatoes in juice	Mixed and chopped
Water	Mixed
Wheat biscuit cereals	Mixed and chopped
Wine, still red	Mixed
Wine, still white	Mixed
Yeast extract	Mixed
Yoghurt	Mixed

APPENDIX 2:
SIMULATED DIETS OF THE 2003/04 NZTDS

Table 1: Mean consumption of each food in the 2003/04 NZTDS for each age-sex group in grams per day based on two-week simulated diets (Brinsdon, 2004)

	25+ yr Male, 82kg	25+ yr Female, 70 kg	19-24 yr Young Male, 78 kg	11-14 yr Boy, 54 kg	11-14 yr Girl, 55 kg	5-6 yr Child, 23 kg	1-3 yr Toddler, 13 kg	6-12 mths Infant, 9 kg
Apples	60	51	42	69	72	75	25	19
Apple based juice	18	14	54	4	6	6	27	9
Apricots, canned	4	4	2	2	3	4	4	5
Avocado	2	4	2	2	2	1	1	1
Bacon	6	3	6	3	1	1	2	1
Banana	34	34	36	26	19	30	35	30
Beans	8	7	7	6	4	3	1	1
Beans, baked	9	6	7	7	6	6	7	4
Beef, mince	38	19	29	20	10	11	9	6
Beef, rump	21	11	21	14	11	6	4	2
Beer	386	32	364	-	-	-	-	-
Beetroot	2	3	2	2	2	1	-	-
Biscuit, chocolate	6	5	7	22	18	14	8	3
Biscuit, cracker	5	5	3	5	5	5	4	4
Biscuit, plain sweet	5	4	6	6	6	6	12	5
Bran flake cereal, mixed	2	2	3	3	3	1	2	1
Bread, mixed grain	26	26	13	12	13	16	2	-
Bread, wheatmeal	26	20	20	21	13	11	8	5
Bread, white	84	50	76	126	90	85	30	19
Broccoli/Cauliflower	10	14	10	9	6	6	5	3
Butter	17	11	23	7	5	5	4	3
Cabbage	14	12	10	10	7	4	1	1
Caffeinated beverage	25	25	100	14	11	-	-	-
Cake	28	22	39	7	11	4	4	1
Capsicum	3	3	4	3	3	1	1	-
Carbonated drink	143	82	275	98	82	41	21	9
Carrot	20	16	17	13	11	11	8	5
Celery	2	3	2	4	2	1	1	-
Cheese	19	15	21	15	15	7	10	8
Chicken	32	27	47	48	31	24	4	3
Chicken nuggets	2	2	7	6	4	3	4	2
Chinese takeaway dish	13	13	14	9	7	-	-	-
Chocolate beverage	36	36	36	64	57	57	21	7
Chocolate, plain milk	6	5	12	13	9	7	1	1
Coffee beans ground	136	86	29	-	-	-	-	-
Coffee instant	300	339	125	7	11	-	-	-
Confectionery	3	3	4	14	9	7	3	1
Corn, canned	8	6	4	5	4	6	2	2
Corned beef	9	7	7	6	4	4	3	2
Cornflakes	5	3	11	8	5	8	4	2
Courgette	3	3	2	3	1	1	1	1
Cream	6	5	5	3	2	1	1	1
Cucumber	3	4	3	3	1	1	1	1
Dairy dessert (Child)	-	-	-	5	9	21	33	9
Egg	22	18	21	16	14	11	8	4

	25+ yr Male, 82kg	25+ yr Female, 70 kg	19-24 yr Young Male, 78 kg	11-14 yr Boy, 54 kg	11-14 yr Girl, 55 kg	5-6 yr Child, 23 kg	1-3 yr Toddler, 13 kg	6-12 mths Infant, 9 kg
Fish, canned	5	4	3	3	3	1	1	2
Fish fingers (Child)	-	-	-	1	2	3	3	2
Fish, battered	10	7	14	7	4	6	3	2
Fish, fresh	20	13	14	12	5	3	2	1
Fruit drink, powdered	43	29	129	69	50	86	59	25
Grapes	3	4	2	1	2	3	1	1
Ham	9	6	4	13	7	5	5	1
Hamburger, plain	14	11	57	21	19	7	6	3
Honey	5	3	5	3	2	2	1	1
Ice-cream	16	10	14	34	26	26	11	6
Infant & Follow on formula	-	-	-	-	-	-	14	350
Infant weaning food, cereal based	-	-	-	-	-	-	-	19
Infant weaning food, custard/fruit dish	-	-	-	-	-	-	-	12
Infant weaning food, savoury dish	-	-	-	-	-	-	9	24
Jam	5	4	4	3	2	2	1	1
Kiwifruit	4	6	3	1	3	6	4	1
Kumara	6	6	3	2	5	1	2	2
Lamb/Mutton	16	9	6	7	6	3	3	2
Lambs liver	2	2	2	-	-	-	-	-
Lettuce	16	14	14	14	9	2	1	-
Margarine/Table spread	13	8	9	9	7	6	3	2
Meat pie	24	9	61	26	23	14	6	4
Melon	2	3	2	1	2	3	2	2
Milk, flavoured	7	7	46	14	14	11	9	-
Milk, trim (0.5%)	110	98	78	23	21	16	14	-
Milk, whole	176	132	188	164	111	144	244	69
Muesli	6	7	7	3	3	1	1	-
Muffin/scone	14	18	6	12	18	10	5	3
Mushrooms	4	6	4	4	3	1	1	1
Mussels	3	1	2	1	1	0	-	-
Nectarines	18	20	6	7	6	9	2	4
Noodles, instant	25	15	21	21	33	21	11	4
Oats, rolled	24	11	4	5	6	5	9	5
Oil	13	8	15	6	4	3	3	1
Onion	19	14	16	9	6	5	1	1
Orange juice	25	21	61	4	6	6	20	8
Oranges	19	26	27	31	51	44	19	8
Oysters	4	2	2	-	-	-	-	-
Pasta, dried	29	20	46	28	19	16	11	8
Peaches, canned	3	4	3	2	3	4	4	4
Peanut butter	2	1	2	5	3	4	1	-
Peanuts	3	1	3	1	1	1	-	-
Pears	9	14	12	9	11	9	5	4
Peas	18	14	14	12	9	6	4	3
Pineapple	5	6	4	2	2	5	1	1
Pizza	16	9	25	11	13	9	5	3

	25+ yr Male, 82kg	25+ yr Female, 70 kg	19-24 yr Young Male, 78 kg	11-14 yr Boy, 54 kg	11-14 yr Girl, 55 kg	5-6 yr Child, 23 kg	1-3 yr Toddler, 13 kg	6-12 mths Infant, 9 kg
Pork chop	13	8	18	8	6	3	1	1
Potato crisps	3	3	8	10	11	6	3	1
Potato, hot chips	32	16	59	50	40	23	15	6
Potatoes, peeled	102	53	64	51	48	39	17	11
Potatoes, with skin	14	14	25	32	26	20	4	3
Prunes	3	2	1	1	1	1	1	1
Pumpkin	14	10	7	4	4	3	6	5
Raisins/Sultanas	4	2	2	2	2	2	7	5
Rice, white	32	29	36	26	14	16	4	2
Salad dressing	4	4	4	2	2	1	-	-
Sausages, beef	16	10	18	21	14	14	11	5
Silverbeet	5	5	6	3	2	2	1	1
Snack bars	2	2	2	9	8	8	2	1
Snacks, flavoured (Child)	-	-	-	9	10	8	4	3
Soy milk	25	29	11	11	18	11	7	-
Soup	25	19	23	11	11	7	4	2
Spaghetti in sauce (canned)	14	11	14	14	11	9	11	7
Strawberries	4	4	2	1	3	1	1	1
Sugar	25	17	18	7	7	4	2	1
Taro	2	1	2	-	-	-	-	-
Tea	421	471	79	18	18	14	-	-
Tomato	31	30	13	17	20	6	5	3
Tomato sauce	9	5	18	8	5	3	4	2
Tomatoes in juice	13	9	16	8	5	4	3	3
Water	218	296	211	347	349	370	250	149
Wheat biscuit cereals	9	4	7	14	7	11	15	5
Wine, still red	20	21	14	-	-	-	-	-
Wine, still white	20	29	14	-	-	-	-	-
Yeast extract	2	1	2	1	1	1	2	2
Yoghurt	11	13	9	14	19	19	62	55
Total weight diet (g/day)	**3461**	**2779**	**3173**	**2042**	**1790**	**1633**	**1275**	**1044**

APPENDIX 3:
LIST OF AGRICULTURAL COMPOUNDS SCREENED FOR IN THE 2003/04 NZTDS AND THEIR LIMITS OF DETECTION (LOD) IN PARTS PER MILLION (MG/KG)

Agricultural compund	LOD
Acephate	0.03
Acetochhlor	0.009
Alachlor	0.009
Aldrin	0.01
Atrazine	0.008
Azaconazole	0.01
Azinphos-methyl	0.01
Azoxystrobin	0.003
Benalaxyl	0.004
Bendiocarb	0.008
Benodanyl	0.01
Bentazone	0.02
BHC - a	0.006
BHC - b	0.006
Bifenthrin	0.006
Binapacryl	0.01
Bitertanol	0.01
Bromacil	0.01
Bromophos-ethyl	0.01
Bromophos(-methyl)	0.005
Bromopropylate	0.007
Bromoxynil	0.02
Bupirimate	0.007
Buprofezin	0.01
Captan	0.003
Carbaryl	0.003
Carbofuran	0.004
Carboxin	0.01
Chlordane-cis	0.01
Chlordane-trans	0.01
Chlorfenvinphos	0.009
Chlorfluazuron	0.05
Chlornitrofen	0.01
Chlorobenzilate	0.003
Chlorothalonil	0.002
Chlorpropham	0.010
Chlorpyriphos	0.003
Chlorpyriphos-methyl	0.002

Agricultural compund	LOD
Chlorsulphuron	0.02
Chlorthal-dimethyl	0.006
Chlozolinate	0.01
Clomazone	0.01
Clopyralid	0.02
Coumaphos	0.01
Cyanazine	0.01
Cyfluthrin	0.02
Cyhalothrin-g	0.008
Cyhalothrin-l	0.010
Cymoxanil	0.02
Cypermethrin	0.015
Cyproconazole	0.009
Cyprodinil	0.003
2,4-D	0.02
2,4-DB	0.02
DDD, 4,4’	0.002
DDD, 2,4’	0.002
DDE, 4,4’	0.002
DDE, 2,4’	0.005
DDT, 2,4’	0.006
DDT, 4,4’	0.01
Deltamethrin	0.01
Demeton-s-methyl	0.01
Diazinon	0.003
Dicamba	0.02
Dichlobenil	0.003
Dichlofenthion	0.007
Dichlofluanid	0.01
Dichlorprop	0.02
Dichlorvos	0.01
Dicloran	0.003
Dicofol	0.002
Dicrotophos	0.03
Dieldrin	0.002
Difenoconazole-cis	0.007
Difenoconazole-trans	0.007
Diflufenican	0.01

Agricultural compund	LOD
Dimethenamid	0.004
Dimethoate	0.01
Dimethomorph	0.01
Diphenamid	0.002
Diphenylamine	0.002
Disulfoton	0.007
Dithiocarbamates	0.01
Endosulfan, a-	0.008
Endosulfan, b-	0.010
Endosulfan-sulphate	0.004
Endrin	0.01
EPN	0.01
Epoxiconazole	0.01
EPTC	0.01
Esfenvalerate	0.01
Ethiofencarb	0.10
Ethion	0.006
Ethoxyquin	0.002
Etridiazole	0.01
Etrimphos	0.008
Famphur	0.004
Fenarimol	0.01
Fenchlorphos	0.005
Fenitrothion	0.001
Fenoxycarb	0.02
Fenpiclonil	0.007
Fenpropathrin	0.005
Fenpropimorph	0.005
Fensulfothion	0.01
Fenthion	0.01
Fenvalerate	0.01
Fipronil	0.01
Flamprop-methyl	0.01
Fluazifop-butyl	0.01
Fluazinam	0.03
Fludioxonil	0.008
Fluometuron	0.01
Flusilasole	0.008

Agricultural compund	LOD
Flutriafol	0.01
Fluvalinate-DL	0.01
Fluvalinate-D	0.01
Folpet	0.02
Furalaxyl	0.01
Furathiocarb	0.008
Halxyfop-methyl	0.01
HCB	0.005
Heptachlor	0.01
Heptachlor endo epoxide	0.01
Heptachlor exo epoxide	0.01
Heptenophos	0.01
Hexaconazole	0.01
Hexazinone	0.01
Indoxacarb	0.004
Iodophenphos	0.01
Iprodione	0.01
Isazophos	0.01
Isofenphos	0.01
Isoproturon	0.01
Kresoxim-methyl	0.008
Lindane	0.010
Linuron	0.006
Malathion	0.007
MCPA	0.02
MCPB	0.02
Mecoprop-P	0.02
Metalaxyl	0.005
Metamitron	0.02
Methacrifos	0.004
Methidathion	0.02
Methiocarb	0.005
Metolachlor	0.003
Metribuzin	0.01
Metsulfuron	0.02
Mevinphos	0.005
Monocrotophos	0.01
Napropamide	0.004

Agricultural compund	LOD
Nitrofen	0.01
Nitrothal-isopropyl	0.01
Norflurazon	0.01
Omethoate	0.01
Oxadiazon	0.01
Oxadixyl	0.01
Oxyfluorfen	0.01
Paclobutrazol	0.01
Parathion(-ethyl)	0.01
Parathion-methyl	0.01
Penconazole	0.004
Pencycuron	0.01
Pendimethalin	0.01
Permethrin-cis	0.01
Permethrin-trans	0.01
Phorate	0.006
Phorate sulphoxide	0.006
Phorate sulphone	0.01
Phosalone	0.01
Phosmet	0.01
Phosphamidon-a	0.01
Phosphamidon-b	0.01
Picloram	0.02
Piperonyl butoxide	0.003
Pirimicarb	0.002
Pirimiphos-methyl	0.002
Prochloraz	0.01
Procymidone	0.003
Prometryn	0.005
Propachlor	0.01
Propargite 1+2	0.01
Propazine	0.007
Propetamphos	0.005
Propham	0.01
Propiconazole-cis	0.002
Propiconazole-trans	0.002
Propoxur	0.005
Propyzamide	0.005

Agricultural compund	LOD
Prothiophos	0.006
Pyrazophos	0.002
Pyrimethanil	0.002
Pyriproxyfen	0.01
Quintozene	0.003
Quizalofop-ethyl	0.009
Sethoxydim	0.02
Simazine	0.01
2,4,5-T	0.02
Tebuconazole	0.006
Tebufenpyrad	0.01
Terbacil	0.006
Terbufos	0.008
Terbumeton	0.004
Terbuthylazine	0.003
Terbutryn	0.008
Tetrachlorvinphos	0.006
Tetradifon	0.01
Thiometon	0.01
Tolclofos-methyl	0.01
Tolylfluanid	0.01
Tralkoxydim	0.01
Triademefon	0.002
Triademenol	0.002
Triallate	0.005
Triasulfuron	0.02
Triazophos	0.01
Triclopyr	0.02
Trifloxystrobin	0.002
Trifluralin	0.01
Vinclozolin	0.004

APPENDIX 4:
LIST OF ELEMENTS IN THE 2003/04 NZTDS AND THEIR LIMITS OF DETECTION (LOD) IN PARTS PER MILLION (MG/KG)

Element	Matrix water (W); liquid or low-fat foods (L); high moisture foods (HM); high-fat or dry solid foods(D)
Arsenic (As)	0.001 (W); 0.001 (L); 0.002 - 0.005 (HM); 0.010 (D)
Cadmium (Cd)	0.00005 (W); 0.0002 (L); 0.0004 (HM); 0.0020 (D)
Iodine (I)	0.001(W); 0.001 (L); 0.002 – 0.005 (HM); 0.010 (D)
Iron (Fe)	0.02(W); 0.1 (L); 0.2 (HM); 1.0 (D)

Element	Matrix water (W); liquid or low-fat foods (L); high moisture foods (HM); high-fat or dry solid foods(D)
Lead (Pb)	0.0001 (W); 0.001 (L); 0.002 - 0.005 (HM); 0.010 (D)
Mercury (Hg) (Total)	0.00008-0.0001 (W); 0.001(L); 0.002-0.005 (HM); 0.010 (D)
Selenium (Se)	0.001 (W); 0.002 (L); 0.004 (HM); 0.010-0.020 (D)
Sodium (Na)	1.0 (W); 5 (L); 10-20 (HM); 50 (D)

APPENDIX 5: ANALYTICAL QUALITY CONTROL PROCEDURES IN THE 2003/04 NZTDS

Trace analyses of a wide range of complex analytes in a variety of complex matrices is an exacting science. For this reason, it is essential to have quality control steps in place to ensure confidence in the methodology and robustness of the results. For this reason the following quality control requirements have been built into the project.

Data quality

All manipulations of spreadsheets and data have checks built in based on ESR database quality management systems. Data is also checked for sense and order of magnitude. All quality control data is assessed and validated before release. Unsatisfactory quality control (QC) data requires an explanation from the laboratory and, where necessary, reanalyses at their expense.

Quality control (QC) data includes the following.

Blanks

Blanks are required in batches to ensure carryover between samples is not occurring and to minimise the risk of false positives.

Duplicates

Duplicates of samples are performed on a selection of samples in each batch to ascertain analytical precision. Coefficients of variation (CV = standard deviation of results divided by mean x 100%) of less than 10% are considered very good but may be acceptable at significantly greater than this, depending on the matrix, analyte and concentration.

Certified Reference Materials (CRMs)

International Certified Reference Materials (CRMs) for a range of different matrices for the analytes in question at a variety of concentrations are also included in each batch to ascertain the accuracy of method. CRMs are samples that have been measured by a range of international laboratories using independent but established methodologies. From these results, justifiable outliers are excluded and a certified range of results for the CRM established. The laboratory should obtain a result within 70-125% of the certified value, depending on the analyte and concentration. It should be noted that the number of international CRMs is quite limited as it would represent an enormous amount of work internationally to have all matrices covered for all analytes at a multiplicity of concentrations by numerous international laboratories. For this reason some degree of compromise is often necessary, possibly the analyte concentration being significantly higher or lower in the CRM than in the sample, or the matrix may be different, although the concentration the same. The situation also arises where many of the analytes (such as some agricultural compounds and vitamins) are unstable to light, air and/or heat, and so CRMs are not internationally available.

Spike recovery

Where CRMs are not available the laboratories were required to spike the analyte into a selection of samples. The amount of analyte measured in the spiked sample, minus the amount in the unspiked sample, divided by the amount of analyte spiked into the sample, times 100, represents the recovery of analyte in that matrix at that concentration. Acceptable recoveries for trace analyses would generally be 70-125%. If outside this window, the results would need to be assessed on a case by case basis.

In-house control samples

Where practicable for the analytes in question, the laboratories were also requested to run an in-house control sample. This is run through all batches, and represents a check on method precision and accuracy from day to day and analyst to analyst.

Blind duplicates

Although ESR is confident that each analytical laboratory has appropriate built-in quality assurance procedures, ESR also believes it is necessary to build into this project provision of repeat samples, which are submitted to the analytical laboratory as 'blind' duplicates. That is, the analyst will not be aware that the samples are duplicates. Results obtained provide an independent and external check on the quality of the data generated.

APPENDIX 6: AGRICULTURAL COMPOUND RESIDUES AND 2003/04 NZTDS FOODS IN WHICH THEY WERE DETECTED OR NOT

In this appendix, all agricultural compounds screened for in the 2003/04 NZTDS are listed in alphabetical order, along with the foods in which they were found, and associated concentrations.

In **Appendix 7**, all foods in the 2003/04 NZTDS are listed alphabetically, with agricultural compound residues detected and their associated concentrations.

Almost all foods in the 2003/04 NZTDS had eight different samples analysed. Generally, foods were analysed as composites, with each composite representing a separate brand or region in either season one or two. Each composite was derived by combining multiple purchases of each individual brand, or different region, for that food.

The main goal of the 2003/04 NZTDS is to estimate dietary exposures to selected chemical residues, contaminant and nutrient elements in the New Zealand food supply, compare these with internationally recognised acceptable exposures or levels, and identify trends in New Zealand over time. To this end, a key characteristic of TDSs is that foods are analysed as for normal consumption (ie. meat cooked, apple cored; fuller details in **Appendix 1**). Agricultural compound residue concentrations reported are thus on a 'sample as consumed and as received basis', that is, at normal moisture content after preparation for consumption.

In recording the minimum and maximum concentrations for each food, normal international convention has been followed for 'not detected' results, namely the result is reported as 'not detected'. The associated limit of reporting for each agricultural compound residue is given in **Appendix 3**.

Mean concentrations of agricultural compounds in 2003/04 NZTDS foods were calculated as simple arithmetic means. Agricultural compounds are intentionally applied to crops at specific times to achieve a specific purpose. Agricultural compound residues may be present at a detectable level, may be present at a level below the limit of detection, or may not be present. Where no residue was detected in the sample, the true concentration of the agricultural compound in that sample was assumed to be zero, an assumption that will be valid in most cases. This is the most commonly used international protocol for estimating dietary exposure to agricultural compounds (FAO/UNEP/WHO, 1985; Gunderson, 1995; FSANZ, 2003). For the purposes of dietary intake estimates, lower bound mean concentrations only were used, with 'not detected' results assigned to zero.

Mean concentrations would normally be rounded, but the mean is an intermediate in the calculation of the estimated dietary exposure, so rounding has been left to the final calculated figure.

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Acephate	not detected in any foods of 2003/04 NZTDS					
Acetochlor	Peanut butter	8	1	0.0011	not detected	0.009
Alachlor	not detected in any foods of 2003/04 NZTDS					
Aldrin	not detected in any foods of 2003/04 NZTDS					
Atrazine	not detected in any foods of 2003/04 NZTDS					
Azaconazole	not detected in any foods of 2003/04 NZTDS					
Azinphos-methyl	Carrot	8	1	0.0014	not detected	0.011
Azoxystrobin	Banana	8	1	0.0014	not detected	0.011
	Cucumber	8	2	0.0016	not detected	0.009
	Grapes	8	1	0.0030	not detected	0.024
	Tomato sauce	8	2	0.0009	not detected	0.004
Benalaxyl	not detected in any foods of 2003/04 NZTDS					
Bendiocarb	not detected in any foods of 2003/04 NZTDS					
Benodanyl	not detected in any foods of 2003/04 NZTDS					
Bentazone	not detected in selected foods of 2003/04 NZTDS					
BHC-a	Peanuts, whole	8	1	0.0008	not detected	0.006
BHC-b	Peanut butter	8	1	0.0014	not detected	0.011
	Peanuts, whole	8	1	0.0025	not detected	0.020
Bifenthrin	Honey	8	3	0.0026	not detected	0.009
	Capsicum	8	1	0.0073	not detected	0.058
	Tomato sauce	8	1	0.0003	not detected	0.002

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Binapacryl	not detected in any foods of 2003/04 NZTDS					
Bitertanol	not detected in any foods of 2003/04 NZTDS					
Bromacil	not detected in any foods of 2003/04 NZTDS					
Bromophos-ethyl	not detected in any foods of 2003/04 NZTDS					
Bromophos(-methyl)	not detected in any foods of 2003/04 NZTDS					
Bromopropylate	Bran flake cereal, mixed	8	1	0.0026	not detected	0.021
Bromoxynil	not detected in selected foods of 2003/04 NZTDS					
Bupirimate	not detected in any foods of 2003/04 NZTDS					
Buprofezin	Tomato	8	1	0.0014	not detected	0.011
Captan	Apple	8	2	0.0029	not detected	0.020
	Grapes	8	2	0.0086	not detected	0.056
	Nectarine	8	4	0.0333	not detected	0.120
	Pear	8	6	0.0591	not detected	0.383
	Raisins/sultanas	8	1	0.0048	not detected	0.039
	Strawberries	8	4	0.9405	not detected	2.740
Carbaryl	Apple	8	2	0.0036	not detected	0.026
	Apricot, canned	8	4	0.4188	not detected	1.440
	Grapes	8	1	0.0044	not detected	0.035
	Infant weaning food, cereal based	8	1	0.0004	not detected	0.003
	Jam	8	1	0.0350	not detected	0.280
	Lettuce	8	1	0.0125	not detected	0.100
	Nectarine	8	4	0.1123	not detected	0.450
	Peaches, canned	8	3	0.0363	not detected	0.180
	Raisins/sultanas	8	1	0.0183	not detected	0.146
	Strawberries	8	1	0.0489	not detected	0.391
	Wine, still red	8	1	0.0036	not detected	0.029
	Yoghurt	8	1	0.0035	not detected	0.028
Carbofuran	not detected in any foods of 2003/04 NZTDS					
Carboxin	not detected in any foods of 2003/04 NZTDS					
Chlordane-cis	not detected in any foods of 2003/04 NZTDS					
Chlordane-trans	not detected in any foods of 2003/04 NZTDS					
Chlorfenvinphos	not detected in any foods of 2003/04 NZTDS					
Chlorfluazuron	not detected in any foods of 2003/04 NZTDS					
Chlornitrofen	not detected in any foods of 2003/04 NZTDS					
Chlorobenzilate	not detected in any foods of 2003/04 NZTDS					
Chlorothalonil	Capsicum	8	1	0.0006	not detected	0.005
	Celery	8	7	0.0320	not detected	0.175
	Cucumber	8	1	0.0030	not detected	0.024
	Lettuce	8	1	0.0013	not detected	0.010
	Tomato	8	1	0.0011	not detected	0.009
Chlorpropham	Potato crisps	8	1	0.0048	not detected	0.038
	Potato, hot chips	8	2	0.0191	not detected	0.080
	Snacks, flavoured	8	1	0.0052	not detected	0.042

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Chlorpyriphos	Apple	8	1	0.0009	not detected	0.007
	Apricot, canned	8	2	0.0078	not detected	0.037
	Bran flake cereal, mixed	8	1	0.0008	not detected	0.006
	Grapes	8	2	0.0193	not detected	0.143
	Hamburger, plain	8	1	0.0015	not detected	0.012
	Jam	8	1	0.0006	not detected	0.005
	Meat pie	8	1	0.0016	not detected	0.013
	Pasta, dried	8	1	0.0005	not detected	0.004
	Pizza	8	1	0.0014	not detected	0.011
	Raisins/sultanas	8	6	0.0154	not detected	0.064
	Sausages	8	3	0.0012	not detected	0.004
	Snack bars	8	1	0.0008	not detected	0.006
Chlorpyriphos-methyl	Biscuit, chocolate	8	2	0.0095	not detected	0.044
	Biscuit, cracker	8	6	0.0586	not detected	0.319
	Biscuits, plain sweet	8	4	0.0250	not detected	0.121
	Bran flake cereal, mixed	8	2	0.0064	not detected	0.028
	Bread, mixed grain	8	8	0.0154	0.002	0.040
	Bread, wheatmeal	8	5	0.0349	not detected	0.141
	Bread, white	8	4	0.0124	not detected	0.039
	Cake	8	4	0.0039	not detected	0.017
	Chicken	8	2	0.0023	not detected	0.012
	Chicken takeaway	8	2	0.0013	not detected	0.008
	Fish, battered	8	1	0.0004	not detected	0.003
	Hamburger, plain	8	2	0.0005	not detected	0.002
	Meat pie	8	1	0.0003	not detected	0.002
	Muesli	8	2	0.0181	not detected	0.117
	Muffin	8	7	0.0225	not detected	0.063
	Noodles, instant	8	2	0.0038	not detected	0.017
	Pasta, dried	8	2	0.0074	not detected	0.048
	Pizza	8	2	0.0028	not detected	0.017
	Raisins/sultanas	8	1	0.0013	not detected	0.011
	Sausages	8	1	0.0003	not detected	0.003
	Snack bars	8	5	0.0185	not detected	0.069
Chlorsulphuron	not detected in selected foods of 2003/04 NZTDS					
Chlorthal-dimethyl	not detected in any foods of 2003/04 NZTDS					
Chlozolinate	not detected in any foods of 2003/04 NZTDS					
Clomazone	not detected in any foods of 2003/04 NZTDS					
Clopyralid	not detected in selected foods of 2003/04 NZTDS					
Coumaphos	not detected in any foods of 2003/04 NZTDS					
Cyanazine	not detected in any foods of 2003/04 NZTDS					
Cyfluthrin	not detected in any foods of 2003/04 NZTDS					
Cyhalothrin-g	Raisins/sultanas	8	1	0.0010	not detected	0.008
Cyhalothrin-l	Bran flake cereal, mixed	8	1	0.0014	not detected	0.011
	Raisins/sultanas	8	2	0.0038	not detected	0.020
Cymoxanil	not detected in selected foods of 2003/04 NZTDS					
Cypermethrin	Bran flake cereal, mixed	8	1	0.0206	not detected	0.165
	Raisins/sultanas	8	3	0.0264	not detected	0.173
	Snacks, flavoured	8	1	0.0018	not detected	0.014

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Cyproconazole	Bran flake cereal, mixed	8	1	0.0017	not detected	0.014
Cyprodinil	Bran flake cereal, mixed	8	1	0.0019	not detected	0.015
	Grapes	8	2	0.0333	not detected	0.239
	Jam	8	1	0.0014	not detected	0.011
	Muesli	8	1	0.0009	not detected	0.007
	Raisins/sultanas	8	2	0.0148	not detected	0.075
	Snack bars	8	1	0.0008	not detected	0.006
	Tomato	8	1	0.0005	not detected	0.004
2,4-D	not detected in selected foods of 2003/04 NZTDS					
2,4-DB	not detected in selected foods of 2003/04 NZTDS					
DDD-4,4′	Courgette	8	2	0.0004	not detected	0.002
	Fish, canned	8	1	0.0035	not detected	0.028
	Fish, fresh	8	1	0.0006	not detected	0.005
DDD-2,4′	Courgette	8	2	0.0006	not detected	0.003
	Fish, canned	8	1	0.0010	not detected	0.008
DDE -4,4′	Bacon	8	4	0.0048	not detected	0.017
	Beef, mince	8	6	0.0048	not detected	0.010
	Beef, rump	8	3	0.0019	not detected	0.012
	Butter	8	8	0.0231	0.011	0.039
	Cake	8	1	0.0003	not detected	0.002
	Carrot	8	1	0.0001	not detected	0.001
	Cheese	8	8	0.0081	0.006	0.013
	Chicken	8	3	0.0033	not detected	0.017
	Chicken takeaway	8	2	0.0015	not detected	0.009
	Chocolate, plain milk	8	4	0.0036	not detected	0.015
	Corned beef	8	6	0.0036	not detected	0.011
	Courgette	8	2	0.0044	not detected	0.030
	Cream	8	8	0.0155	0.002	0.041
	Dairy dessert	8	1	0.0004	not detected	0.003
	Egg	8	4	0.0024	not detected	0.008
	Fish, battered	8	1	0.0001	not detected	0.001
	Fish, canned	8	2	0.0026	not detected	0.019
	Fish, fresh	8	4	0.0020	not detected	0.011
	Ham	8	1	0.0013	not detected	0.010
	Hamburger, plain	8	4	0.0013	not detected	0.004
	Ice-cream	8	5	0.0046	not detected	0.011
	Lamb/mutton	8	5	0.0055	not detected	0.014
	Meat pie	8	4	0.0013	not detected	0.005
	Milk, 3.25% fat	8	2	0.0004	not detected	0.002
	Milk, flavoured	8	1	0.0001	not detected	0.001
	Muffin	8	2	0.0005	not detected	0.002
	Peanut butter	8	1	0.0003	not detected	0.002
	Pizza	8	4	0.0026	not detected	0.007
	Pork chop	8	4	0.0053	not detected	0.018
	Sausages	8	6	0.0097	not detected	0.023
	Silverbeet	8	1	0.0006	not detected	0.005
	Yoghurt	8	1	0.0003	not detected	0.002
DDE, 2,4′	not detected in any foods of 2003/04 NZTDS					
DDT, 2,4′	not detected in any foods of 2003/04 NZTDS					
DDT, 4,4′	not detected in any foods of 2003/04 NZTDS					

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Deltamethrin	not detected in any foods of 2003/04 NZTDS					
Demeton-s-methyl	not detected in any foods of 2003/04 NZTDS					
Diazinon	Apple	8	2	0.0008	not detected	0.003
	Celery	8	2	0.0245	not detected	0.135
	Jam	8	1	0.0026	not detected	0.021
	Meat pie	8	1	0.0004	not detected	0.003
Dicamba	not detected in selected foods of 2003/04 NZTDS					
Dichlobenil	not detected in any foods of 2003/04 NZTDS					
Dichlofenthion	not detected in any foods of 2003/04 NZTDS					
Dichlofluanid	Biscuit, cracker	8	1	0.0084	not detected	0.067
	Cake	8	1	0.0076	not detected	0.061
	Muesli	8	1	0.0179	not detected	0.143
	Pear	8	2	0.0156	not detected	0.113
	Wine, still red	8	1	0.0054	not detected	0.043
Dichlorprop	not detected in selected foods of 2003/04 NZTDS					
Dichlorvos	Biscuit, chocolate	8	1	0.0019	not detected	0.015
Dicloran	Capsicum	8	1	0.0005	not detected	0.004
	Kumara	8	4	0.0576	not detected	0.260
	Mushrooms	8	1	0.0004	not detected	0.003
Dicofol	Grapes	8	1	0.0003	not detected	0.002
	Muesli	8	1	0.0103	not detected	0.083
	Muffin	8	1	0.0005	not detected	0.004
	Prunes	8	1	0.0008	not detected	0.006
	Raisins/sultanas	8	3	0.0267	not detected	0.129
Dicrotophos	not detected in any foods of 2003/04 NZTDS					
Dieldrin	Courgette	8	1	0.0023	not detected	0.018
	Pumpkin	8	5	0.0080	not detected	0.023
Difenoconazole, cis	Celery	8	2	0.0040	not detected	0.025
	Silverbeet	8	1	0.0025	not detected	0.020
Difenoconazole, trans	Celery	8	2	0.0075	not detected	0.046
	Silverbeet	8	1	0.0049	not detected	0.039
Diflufenican	Oil	8	1	0.0018	not detected	0.014
Dimethenamid	not detected in any foods of 2003/04 NZTDS					
Dimethoate	Capsicum	8	4	0.0778	not detected	0.301
	Courgette	8	4	0.6854	not detected	2.350
	Cucumber	8	1	0.0376	not detected	0.301
	Melons	8	3	0.0655	not detected	0.288
Dimethomorph	not detected in any foods of 2003/04 NZTDS					
Diphenamid	not detected in any foods of 2003/04 NZTDS					
Diphenylamine	Apple	8	6	0.0500	not detected	0.248
	Apple-based juice	8	1	0.0306	not detected	0.245
	Apricot, canned	8	2	0.0006	not detected	0.003
	Biscuit, chocolate	8	1	0.0005	not detected	0.004
	Bread, wheatmeal	8	1	0.0003	not detected	0.002
	Butter	8	8	0.0074	0.006	0.009
	Caffeinated beverage	8	1	0.0019	not detected	0.015
	Cheese	8	8	0.0030	0.003	0.003
	Chinese dish	8	2	0.0006	not detected	0.003
	Cream	8	8	0.0045	0.002	0.009

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Diphenylamine (ctd)	Ice-cream	8	1	0.0001	not detected	0.001
	Infant weaning food, cereal based	8	4	0.0054	not detected	0.020
	Infant weaning food, custard/fruit dish	8	1	0.0006	not detected	0.005
	Lamb/mutton	8	1	0.0004	not detected	0.003
	Peanut butter	8	5	0.0029	not detected	0.006
	Pear	8	4	0.3439	not detected	1.140
	Snack bars	8	2	0.0010	not detected	0.004
Disulfoton	not detected in any foods of 2003/04 NZTDS					
Dithiocarbamates	Apple	8	1	0.0050	not detected	0.04
	Apple-based juice	8	1	0.0100	not detected	0.08
	Apricot, canned	8	4	0.5250	not detected	2.54
	Avocado	8	3	0.0174	not detected	0.06
	Beans	8	4	0.0723	not detected	0.50
	Beans, baked, canned	8	2	0.0075	not detected	0.04
	Broccoli/cauliflower	8	8	0.2325	0.04	0.58
	Cabbage	8	8	0.3925	0.08	1.14
	Capsicum	8	2	0.0200	not detected	0.08
	Carrot	8	4	0.0175	not detected	0.06
	Celery	8	6	0.0650	not detected	0.20
	Corn, canned	8	1	0.0025	not detected	0.02
	Courgette	8	1	0.0025	not detected	0.02
	Grapes	8	2	0.0800	not detected	0.50
	Lettuce	8	3	0.0250	not detected	0.12
	Mushrooms	8	2	0.0179	not detected	0.12
	Nectarine	8	2	0.0515	not detected	0.24
	Onion	8	6	0.0375	not detected	0.08
	Pear	8	3	0.0250	not detected	0.08
	Peas	8	4	0.0213	not detected	0.05
	Prunes	8	2	0.0300	not detected	0.22
	Raisins/sultanas	8	1	0.0125	not detected	0.10
	Silverbeet	8	3	0.1925	not detected	0.80
	Strawberries	8	2	0.0099	not detected	0.04
	Taro	8	1	0.0075	not detected	0.06
	Tomato	8	3	0.0275	not detected	0.08
	Tomato sauce	8	3	0.0100	not detected	0.04
Endosulfan -a	Capsicum	8	2	0.0040	not detected	0.022
	Courgette	8	1	0.0014	not detected	0.011
	Cucumber	8	1	0.0026	not detected	0.021
	Peanut butter	8	1	0.0121	not detected	0.097
	Tomato	8	4	0.0318	not detected	0.102
Endosulfan -b	Capsicum	8	2	0.0074	not detected	0.048
	Cucumber	8	1	0.0021	not detected	0.017
	Peanut butter	8	1	0.0024	not detected	0.019
	Tomato	8	4	0.0330	not detected	0.113

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Endosulfan sulphate	Capsicum	8	1	0.0024	not detected	0.019
	Courgette	8	4	0.0063	not detected	0.034
	Cucumber	8	1	0.0025	not detected	0.020
	Oil	8	5	0.0400	not detected	0.145
	Peanuts, whole	8	1	0.0016	not detected	0.013
	Pear	8	1	0.0004	not detected	0.003
	Salad dressing	8	2	0.0101	not detected	0.041
	Tomato	8	3	0.0134	not detected	0.060
Endrin	not detected in any foods of 2003/04 NZTDS					
EPN	not detected in any foods of 2003/04 NZTDS					
Epoxiconazole	not detected in any foods of 2003/04 NZTDS					
EPTC	not detected in any foods of 2003/04 NZTDS					
Esfenvalerate	not detected in any foods of 2003/04 NZTDS					
Ethiofencarb	not detected in any foods of 2003/04 NZTDS					
Ethion	not detected in any foods of 2003/04 NZTDS					
Ethoxyquin	Chicken	8	5	0.0093	not detected	0.042
	Chicken takeaway	8	8	0.0584	0.017	0.121
	Corned beef	8	1	0.0008	not detected	0.007
	Egg	8	6	0.0112	not detected	0.022
	Fish, fresh	8	1	0.0875	not detected	0.700
	Sausages	8	3	0.0046	not detected	0.020
	Snacks, flavoured	8	1	0.0007	not detected	0.005
Etridiazole	not detected in any foods of 2003/04 NZTDS					
Etrimphos	not detected in any foods of 2003/04 NZTDS					
Famphur	not detected in any foods of 2003/04 NZTDS					
Fenarimol	not detected in any foods of 2003/04 NZTDS					
Fenchlorphos	not detected in any foods of 2003/04 NZTDS					
Fenitrothion	Biscuit, cracker	8	1	0.0441	not detected	0.353
	Biscuits, plain sweet	8	1	0.0023	not detected	0.018
	Bran flake cereal, mixed	8	2	0.0136	not detected	0.066
	Bread, mixed grain	8	2	0.0209	not detected	0.106
	Bread, wheatmeal	8	3	0.1105	not detected	0.570
	Bread, white	8	2	0.0253	not detected	0.142
	Cake	8	1	0.0044	not detected	0.035
	Fish, battered	8	1	0.0024	not detected	0.019
	Meat pie	8	4	0.0080	not detected	0.033
	Muesli	8	2	0.0103	not detected	0.047
	Muffin	8	4	0.0139	not detected	0.066
	Oats, rolled	8	2	0.0056	not detected	0.034
	Pizza	8	5	0.0345	not detected	0.161
	Sausages	8	1	0.0018	not detected	0.014
	Snack bars	8	3	0.0090	not detected	0.041
	Soy milk	8	1	0.0004	not detected	0.003
Fenoxycarb	not detected in any foods of 2003/04 NZTDS					
Fenpiclonil	not detected in any foods of 2003/04 NZTDS					
Fenpropathrin	Raisins/sultanas	8	1	0.0055	not detected	0.044
Fenpropimorph	not detected in any foods of 2003/04 NZTDS					

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Fensulfothion	not detected in any foods of 2003/04 NZTDS					
Fenthion	not detected in any foods of 2003/04 NZTDS					
Fenvalerate	Jam	8	1	0.0015	not detected	0.012
	Prunes	8	1	0.0023	not detected	0.018
	Raisins/sultanas	8	1	0.0054	not detected	0.043
Fipronil	not detected in any foods of 2003/04 NZTDS					
Flamprop-methyl	not detected in any foods of 2003/04 NZTDS					
Fluazifop-butyl	not detected in any foods of 2003/04 NZTDS					
Fluazinam	not detected in any foods of 2003/04 NZTDS					
Fludioxinil	Grapes	8	1	0.0011	not detected	0.009
	Jam	8	1	0.0010	not detected	0.008
Fluometuron	not detected in any foods of 2003/04 NZTDS					
Flusilasole	not detected in any foods of 2003/04 NZTDS					
Flutriafol	not detected in any foods of 2003/04 NZTDS					
Fluvalinate-DL	not detected in any foods of 2003/04 NZTDS					
Fluvalinate-D	not detected in any foods of 2003/04 NZTDS					
Folpet	not detected in any foods of 2003/04 NZTDS					
Furalaxyl	not detected in any foods of 2003/04 NZTDS					
Furathiocarb	not detected in any foods of 2003/04 NZTDS					
Halxyfop-methyl	not detected in any foods of 2003/04 NZTDS					
HCB	not detected in any foods of 2003/04 NZTDS					
Heptachlor	not detected in any foods of 2003/04 NZTDS					
Heptachlor endo epoxide	not detected in any foods of 2003/04 NZTDS					
Heptachlor exo epoxide	not detected in any foods of 2003/04 NZTDS					
Heptenophos	not detected in any foods of 2003/04 NZTDS					
Hexaconazole	not detected in any foods of 2003/04 NZTDS					
Hexazinone	not detected in any foods of 2003/04 NZTDS					
Indoxacarb	Apple	8	3	0.0016	not detected	0.008
	Broccoli/cauliflower	8	2	0.0020	not detected	0.010
	Pear	8	3	0.0025	not detected	0.012
Iodophenphos	not detected in any foods of 2003/04 NZTDS					

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Iprodione	Apple-based juice	8	1	0.0154	not detected	0.123
	Apricot, canned	8	6	0.3344	not detected	1.110
	Banana	8	1	0.0200	not detected	0.160
	Bran flake cereal, mixed	8	1	0.0083	not detected	0.066
	Capsicum	8	1	0.0113	not detected	0.090
	Grapes	8	2	0.0221	not detected	0.100
	Infant weaning food, cereal based	8	4	0.0260	not detected	0.115
	Jam	8	1	0.0036	not detected	0.029
	Muesli	8	2	0.0075	not detected	0.041
	Nectarine	8	4	0.4675	not detected	1.800
	Peaches, canned	8	3	0.0055	not detected	0.019
	Pear	8	4	0.1448	not detected	0.386
	Raisins/sultanas	8	7	0.0482	not detected	0.104
	Salad dressing	8	1	0.0033	not detected	0.026
	Snack bars	8	1	0.0058	not detected	0.046
	Strawberries	8	4	0.1609	not detected	0.630
	Tomato	8	1	0.0143	not detected	0.114
	Wine, still red	8	7	0.0395	not detected	0.112
	Wine, still white	8	7	0.0155	not detected	0.025
	Yoghurt	8	2	0.0036	not detected	0.025
Isazophos	not detected in any foods of 2003/04 NZTDS					
Isofenphos	not detected in any foods of 2003/04 NZTDS					
Isoproturon	not detected in any foods of 2003/04 NZTDS					
Kresoxim-methyl	Grapes	8	1	0.0008	not detected	0.006
Lindane	not detected in any foods of 2003/04 NZTDS					
Linuron	Carrot	8	1	0.0040	not detected	0.032
MCPA	not detected in selected foods of 2003/04 NZTDS					
MCPB	not detected in selected foods of 2003/04 NZTDS					
Malathion	Biscuit, chocolate	8	2	0.0018	not detected	0.010
	Biscuit, cracker	8	3	0.0094	not detected	0.034
	Biscuits, plain sweet	8	3	0.0100	not detected	0.043
	Bread, wheatmeal	8	1	0.0015	not detected	0.012
	Cream	8	1	0.0014	not detected	0.011
	Muesli	8	1	0.0046	not detected	0.037
Mecoprop-P	not detected in selected foods of 2003/04 NZTDS					
Metalaxyl	Cucumber	8	3	0.0160	not detected	0.090
	Tomato	8	1	0.0015	not detected	0.012
Metamitron	not detected in selected foods of 2003/04 NZTDS					
Metasulfuron	not detected in selected foods of 2003/04 NZTDS					
Methacrifos	not detected in any foods of 2003/04 NZTDS					
Methidathion	not detected in any foods of 2003/04 NZTDS					
Methiocarb	not detected in any foods of 2003/04 NZTDS					
Metolachlor	not detected in any foods of 2003/04 NZTDS					
Metribuzin	not detected in any foods of 2003/04 NZTDS					
Mevinphos	not detected in any foods of 2003/04 NZTDS					
Monocrotophos	not detected in any foods of 2003/04 NZTDS					
Napropamide	not detected in any foods of 2003/04 NZTDS					
Nitrofen	not detected in any foods of 2003/04 NZTDS					
Nitrothal-isopropyl	not detected in any foods of 2003/04 NZTDS					

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Norflurazon	not detected in any foods of 2003/04 NZTDS					
Omethoate	Courgette	8	4	0.0441	not detected	0.162
	Cucumber	8	1	0.0014	not detected	0.011
Oxadiazon	not detected in any foods of 2003/04 NZTDS					
Oxadixyl	not detected in any foods of 2003/04 NZTDS					
Oxyfluorfen	not detected in any foods of 2003/04 NZTDS					
Paclobutrazol	not detected in any foods of 2003/04 NZTDS					
Parathion(-ethyl)	not detected in any foods of 2003/04 NZTDS					
Parathion-methyl	Raisins/sultanas	8	1	0.0047	not detected	0.037
Penconazole	Cucumber	8	1	0.0010	not detected	0.008
Pencycuron	Potatoes, peeled	8	1	0.0016	not detected	0.013
Pendimethalin	not detected in any foods of 2003/04 NZTDS					
Permethrin-cis	Beef, mince	8	1	0.0005	not detected	0.004
	Beef, rump	8	1	0.0001	not detected	0.001
	Celery	8	1	0.0005	not detected	0.004
	Cucumber	8	1	0.0004	not detected	0.003
	Hamburger, plain	8	1	0.0005	not detected	0.004
	Tomato	8	3	0.0056	not detected	0.024
	Wheat biscuit cereals	8	1	0.0003	not detected	0.002
Permethrin-trans	Beef, mince	8	1	0.0015	not detected	0.012
	Beef, rump	8	1	0.0005	not detected	0.004
	Celery	8	1	0.0003	not detected	0.002
	Cucumber	8	1	0.0005	not detected	0.004
	Hamburger, plain	8	1	0.0008	not detected	0.006
	Tomato	8	3	0.0056	not detected	0.025
	Wheat biscuit cereals	8	1	0.0009	not detected	0.007
Phorate	not detected in any foods of 2003/04 NZTDS					
Phorate sulphoxide	Carrot	8	2	0.0033	not detected	0.013
	Potatoes, with skin	8	1	0.0028	not detected	0.022
Phorate sulphone	Carrot	8	2	0.0086	not detected	0.061
	Peanuts, whole	8	1	0.0050	not detected	0.040
	Potatoes, with skin	8	1	0.0010	not detected	0.008
Phosalone	not detected in any foods of 2003/04 NZTDS					
Phosmet	Nectarine	8	2	0.0888	not detected	0.675
Phosphamidon-a	not detected in any foods of 2003/04 NZTDS					
Phosphamidon-b	not detected in any foods of 2003/04 NZTDS					
Picloram	not detected in selected foods of 2003/04 NZTDS					
Piperonyl butoxide	Apple	8	1	0.0033	not detected	0.026
	Beef, rump	8	1	0.0050	not detected	0.040
	Chicken takeaway	8	1	0.0013	not detected	0.010
	Chinese dish	8	1	0.0076	not detected	0.061
	Lamb/mutton	8	1	0.0004	not detected	0.003
	Muesli	8	1	0.0009	not detected	0.007
	Muffin	8	1	0.0059	not detected	0.047
	Mushrooms	8	1	0.0009	not detected	0.007
	Peanut butter	8	1	0.0049	not detected	0.039
	Raisins/sultanas	8	2	0.0545	not detected	0.373
	Rice, white	8	1	0.0018	not detected	0.014
	Sausages	8	1	0.0011	not detected	0.009
	Wheat biscuit cereals	8	1	0.0016	not detected	0.013

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Pirimicarb	Celery	8	1	0.0003	not detected	0.002
	Courgette	8	2	0.0131	not detected	0.082
	Cucumber	8	1	0.0011	not detected	0.009
	Lettuce	8	2	0.1354	not detected	0.977
Pirimiphos-methyl	Biscuit, chocolate	8	5	0.1234	not detected	0.870
	Biscuit, cracker	8	6	0.2003	not detected	1.285
	Biscuits, plain sweet	8	8	0.1184	0.003	0.325
	Bran flake cereal, mixed	8	5	0.0088	not detected	0.030
	Bread, mixed grain	8	8	0.1386	0.05	0.230
	Bread, wheatmeal	8	8	0.1315	0.016	0.290
	Bread, white	8	8	0.0701	0.003	0.140
	Celery	8	1	0.0142	not detected	0.114
	Chicken	8	3	0.0065	not detected	0.024
	Chicken takeaway	8	4	0.0016	not detected	0.005
	Chinese dish	8	2	0.0024	not detected	0.016
	Cucumber	8	1	0.0005	not detected	0.004
	Fish fingers	8	8	0.0409	0.014	0.053
	Fish, battered	8	4	0.0071	not detected	0.021
	Hamburger, plain	8	7	0.0181	not detected	0.045
	Meat pie	8	7	0.0249	not detected	0.058
	Muesli	8	5	0.0243	not detected	0.153
	Muffin	8	5	0.0151	not detected	0.038
	Pasta, dried	8	2	0.0041	not detected	0.032
	Peanut butter	8	5	0.0088	not detected	0.029
	Peanuts, whole	8	2	0.0058	not detected	0.025
	Pizza	8	8	0.0404	0.009	0.080
	Rice, white	8	1	0.0030	not detected	0.024
	Sausages	8	8	0.0273	0.013	0.047
	Snack bars	8	3	0.0060	not detected	0.022
	Snacks, flavoured	8	4	0.0026	not detected	0.010
	Tomato	8	3	0.0278	not detected	0.154
	Wheat biscuit cereals	8	7	0.0276	not detected	0.091
Prochloraz	not detected in any foods of 2003/04 NZTDS					
Procymidone	Beans	8	4	0.0530	not detected	0.181
	Bran flake cereal, mixed	8	1	0.0026	not detected	0.021
	Capsicum	8	2	0.0314	not detected	0.220
	Carrot	8	1	0.0019	not detected	0.015
	Celery	8	1	0.0004	not detected	0.003
	Chinese dish	8	2	0.0019	not detected	0.010
	Lettuce	8	2	0.0019	not detected	0.010
	Melons	8	1	0.0003	not detected	0.002
	Muesli	8	2	0.0120	not detected	0.059
	Muffin	8	1	0.0018	not detected	0.014
	Nectarine	8	1	0.0094	not detected	0.075
	Oil	8	1	0.0071	not detected	0.057
	Peaches, canned	8	1	0.0033	not detected	0.026
	Raisins/sultanas	8	7	0.0866	not detected	0.260
	Snack bars	8	2	0.0159	not detected	0.119
	Tomato sauce	8	1	0.0024	not detected	0.019
	Tomatoes in juice	8	1	0.0018	not detected	0.014
	Wine, still red	8	3	0.0040	not detected	0.016

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Prometryn	not detected in any foods of 2003/04 NZTDS					
Propachlor	not detected in any foods of 2003/04 NZTDS					
Propargite 1+2	Bran flake cereal, mixed	8	1	0.0025	not detected	0.020
	Muesli	8	1	0.0020	not detected	0.016
	Muffin	8	1	0.0023	not detected	0.018
	Prunes	8	3	0.0328	not detected	0.200
	Raisins/sultanas	8	5	0.0588	not detected	0.187
Propazine	Celery	8	1	0.0015	not detected	0.012
Propetamphos	not detected in any foods of 2003/04 NZTDS					
Propham	Apple	8	1	0.0019	not detected	0.015
	Capsicum	8	1	0.0081	not detected	0.065
	Fish, battered	8	2	0.0043	not detected	0.024
	Potato crisps	8	4	0.2251	not detected	0.808
	Potato, hot chips	8	2	0.0454	not detected	0.353
	Potatoes, peeled	8	4	0.1293	not detected	0.479
	Potatoes, with skin	8	4	0.2793	not detected	1.040
	Silverbeet	8	1	0.0009	not detected	0.007
Propiconazole-cis	Apricot, canned	8	1	0.0024	not detected	0.019
	Peaches, canned	8	1	0.0003	not detected	0.002
Propiconazole-trans	Apricot, canned	8	1	0.0034	not detected	0.027
	Peaches, canned	8	1	0.0004	not detected	0.003
Propoxur	Meat pie	8	1	0.0021	not detected	0.017
Propyzamide	not detected in any foods of 2003/04 NZTDS					
Prothiophos	Grapes	8	1	0.0008	not detected	0.006
Pyrazophos	Cucumber	8	1	0.0003	not detected	0.002
Pyrimethanil	Grapes	8	2	0.0008	not detected	0.004
	Muesli	8	1	0.0019	not detected	0.015
	Strawberries	8	3	0.0630	not detected	0.465
	Wine, still red	8	4	0.0950	not detected	0.411
	Wine, still white	8	3	0.0288	not detected	0.146
Pyriproxyfen	not detected in any foods of 2003/04 NZTDS					
Quintozene	Capsicum	8	1	0.0010	not detected	0.008
	Peanuts, whole	8	1	0.0005	not detected	0.004
	Snacks, flavoured	8	1	0.0026	not detected	0.021
Quizalofop-ethyl	not detected in any foods of 2003/04 NZTDS					
Sethoxydim	Chicken takeaway	8	1	0.0090	not detected	0.072
Simazine	Oil	8	2	0.0375	not detected	0.290
2,4,5-T	not detected in selected foods of 2003/04 NZTDS					
Tebuconazole	Grapes	8	2	0.0041	not detected	0.023
	Wine, still white	8	1	0.0008	not detected	0.006
Tebufenpyrad	Grapes	8	2	0.0041	not detected	0.023
Terbacil	not detected in any foods of 2003/04 NZTDS					
Terbufos	Oil	8	4	0.0046	not detected	0.011
Terbumeton	not detected in any foods of 2003/04 NZTDS					
Terbutylazine	Cucumber	8	1	0.0004	not detected	0.003
	Oil	8	1	0.0143	not detected	0.114
Terbutryn	not detected in any foods of 2003/04 NZTDS					
Tetrachlorvinphos	Milk, 3.25% fat	8	1	0.0011	not detected	0.009
Tetradifon	not detected in any foods of 2003/04 NZTDS					
Thiometon	not detected in any foods of 2003/04 NZTDS					

Agricultural compound residue	2003/04 NZTDS Food	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Tolclofos-methyl	not detected in any foods of 2003/04 NZTDS					
Tolylfluanid	Pear	8	1	0.0399	not detected	0.319
	Strawberries	8	3	0.6120	not detected	2.420
Tralkoxydim	not detected in any foods of 2003/04 NZTDS					
Triademefon	Grapes	8	1	0.0005	not detected	0.004
Triademenol	Cucumber	8	2	0.0008	not detected	0.004
	Grapes	8	1	0.0019	not detected	0.016
Triallate	not detected in any foods of 2003/04 NZTDS					
Triaulfuron	not detected in selected foods of 2003/04 NZTDS					
Triazophos	not detected in any foods of 2003/04 NZTDS					
Triclopyr	not detected in selected foods of 2003/04 NZTDS					
Trifloxystrobin	Apple	8	1	0.0003	not detected	0.002
Trifluralin	not detected in any foods of 2003/04 NZTDS					
Vinclozolin	Kiwifruit	8	4	0.0034	not detected	0.011

APPENDIX 7: FOODS OF THE 2003/04 NZTDS, AND AGRICULTURAL COMPOUND RESIDUES DETECTED

In this appendix, all foods in the 2003/04 NZTDS are listed alphabetically, with agricultural compound residues detected and their associated concentrations.

In **Appendix 6**, all agricultural compounds screened for in the 2003/04 NZTDS are listed in alphabetical order, along with the foods in which they were found, and associated concentrations.

Almost all foods in the 2003/04 NZTDS had eight different samples analysed. Generally, foods were analysed as composites, with each composite representing a separate brand or region in either season one or two. Each composite was derived by combining multiple purchases of each individual brand, or different region, for that food.

The main goal of the 2003/04 NZTDS is to estimate dietary exposures to selected chemical residues, contaminant and nutrient elements in the New Zealand food supply, compare these with internationally recognised acceptable exposures or levels, and identify trends in New Zealand over time. To this end, a key characteristic of TDSs is that foods are analysed as for normal consumption (ie. meat cooked, apple cored; fuller details in **Appendix 1**). Agricultural compound residue concentrations reported are thus on a 'sample as consumed and as received basis', that is, at normal moisture content after preparation for consumption.

In recording the minimum and maximum concentrations for each food, normal international convention has been followed for 'not detected' results, namely the result is reported as 'not detected'. The associated limit of reporting for each agricultural compound residue is given in **Appendix 3**.

Mean concentrations of agricultural compounds in 2003/04 NZTDS foods were calculated as simple arithmetic means. Agricultural compounds are intentionally applied to crops at specific times to achieve a specific purpose. Agricultural compound residues may be present at a detectable level, may be present at a level below the limit of detection, or may not be present. Where no residue was detected in the sample, the true concentration of the agricultural compound in that sample was assumed to be zero, an assumption that will be valid in most cases. This is the most commonly used international protocol for estimating dietary exposure to agricultural compounds (FAO/UNEP/WHO, 1985; Gunderson, 1995; FSANZ, 2003). For the purposes of dietary intake estimates, lower bound mean concentrations only were used, with 'not detected' results assigned to zero.

Mean concentrations would normally be rounded, but the mean is an intermediate in the calculation of the estimated dietary exposure, so rounding has been left to the final calculated figure.

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	Captan	8	2	0.0029	not detected	0.020
	Carbaryl	8	2	0.0036	not detected	0.026
	Chlorpyriphos	8	1	0.0009	not detected	0.007
	Diazinon	8	2	0.0008	not detected	0.003
	Diphenylamine	8	6	0.0500	not detected	0.248
	Dithiocarbamates	8	1	0.0025	not detected	0.02
	Indoxacarb	8	3	0.0016	not detected	0.008
	Piperonyl butoxide	8	1	0.0033	not detected	0.026
	Propham	8	1	0.0019	not detected	0.015
	Trifloxystrobin	8	1	0.0003	not detected	0.002
Apple-based juice	Diphenylamine	8	1	0.0306	not detected	0.245
	Dithiocarbamates	8	1	0.0050	not detected	0.04
	Iprodione	8	1	0.0154	not detected	0.123
Apricot, canned	Carbaryl	8	4	0.4188	not detected	1.440
	Chlorpyriphos	8	2	0.0078	not detected	0.037
	Diphenylamine	8	2	0.0006	not detected	0.003
	Dithiocarbamates	8	4	0.2625	not detected	1.27
	Iprodione	8	6	0.3344	not detected	1.110
	Propiconazole-cis	8	1	0.0024	not detected	0.019
	Propiconazole-trans	8	1	0.0034	not detected	0.027
Avocado	Dithiocarbamates	8	3	0.0087	not detected	0.030
Bacon	DDE -4,4'	8	4	0.0048	not detected	0.017
Banana	Azoxystrobin	8	1	0.0014	not detected	0.011
	Dithiocarbamates	8	4	0.0361	not detected	0.25
	Iprodione	8	1	0.0200	not detected	0.160

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Beans	Procymidone	8	4	0.0530	not detected	0.181
Beans, baked, canned	Dithiocarbamates	8	2	0.0038	not detected	0.02
Beef, mince	DDE -4,4'	8	6	0.0048	not detected	0.010
	Permethrin-cis	8	1	0.0005	not detected	0.004
	Permethrin-trans	8	1	0.0015	not detected	0.012
Beef, rump	DDE -4,4'	8	3	0.0019	not detected	0.012
	Permethrin-cis	8	1	0.0001	not detected	0.001
	Permethrin-trans	8	1	0.0005	not detected	0.004
	Piperonyl butoxide	8	1	0.0050	not detected	0.040
Beer		8	0	no agricultural compound residues detected		
Beetroot, canned		8	0	no agricultural compound residues detected		
Biscuit, chocolate	Chlorpyriphos-methyl	8	2	0.0095	not detected	0.044
	Dichlorvos	8	1	0.0019	not detected	0.015
	Diphenylamine	8	1	0.0005	not detected	0.004
	Malathion	8	2	0.0018	not detected	0.010
	Pirimiphos-methyl	8	5	0.1234	not detected	0.870
Biscuit, cracker	Chlorpyriphos-methyl	8	6	0.0586	not detected	0.319
	Dichlofluanid	8	1	0.0084	not detected	0.067
	Fenitrothion	8	1	0.0441	not detected	0.353
	Malathion	8	3	0.0094	not detected	0.034
	Pirimiphos-methyl	8	6	0.2003	not detected	1.285
Biscuits, plain sweet	Chlorpyriphos-methyl	8	4	0.0250	not detected	0.121
	Fenitrothion	8	1	0.0023	not detected	0.018
	Malathion	8	3	0.0100	not detected	0.043
	Pirimiphos-methyl	8	8	0.1184	0.003	0.325
Bran flake cereal, mixed	Bromopropylate	8	1	0.0026	not detected	0.021
	Chlorpyriphos	8	1	0.0008	not detected	0.006
	Chlorpyriphos-methyl	8	2	0.0064	not detected	0.028
	Cyhalothrin-i	8	1	0.0014	not detected	0.011
	Cypermethrin	8	1	0.0206	not detected	0.165
	Cyproconazole	8	1	0.0017	not detected	0.014
	Cyprodinil	8	1	0.0019	not detected	0.015
	Fenitrothion	8	2	0.0136	not detected	0.066
	Iprodione	8	1	0.0083	not detected	0.066
	Pirimiphos-methyl	8	5	0.0088	not detected	0.030
	Procymidone	8	1	0.0026	not detected	0.021
	Propargite 1+2	8	1	0.0025	not detected	0.020
Bread, mixed grain	Chlorpyriphos-methyl	8	8	0.0154	0.002	0.040
	Fenitrothion	8	2	0.0209	not detected	0.106
	Pirimiphos-methyl	8	8	0.1386	0.050	0.230
Bread, wheatmeal	Chlorpyriphos-methyl	8	5	0.0349	not detected	0.141
	Diphenylamine	8	1	0.0003	not detected	0.002
	Fenitrothion	8	3	0.1105	not detected	0.570
	Malathion	8	1	0.0015	not detected	0.012
	Pirimiphos-methyl	8	8	0.1315	0.016	0.290
Bread, white	Chlorpyriphos-methyl	8	4	0.0124	not detected	0.039
	Fenitrothion	8	2	0.0253	not detected	0.142
	Pirimiphos-methyl	8	8	0.0701	0.003	0.140
Broccoli/ cauliflower	Dithiocarbamates	8	8	0.1163	0.02	0.29
	Indoxacarb	8	2	0.0020	not detected	0.010

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Butter	DDE -4,4’	8	8	0.0231	0.011	0.039
	Diphenylamine	8	8	0.0074	0.006	0.009
Cabbage	Dithiocarbamates	8	8	0.1963	0.04	0.57
Caffeinated beverage	Diphenylamine	8	1	0.0019	not detected	0.015
Cake	Chlorpyriphos-methyl	8	4	0.0039	not detected	0.017
	DDE -4,4’	8	1	0.0003	not detected	0.002
	Dichlofluanid	8	1	0.0076	not detected	0.061
	Fenitrothion	8	1	0.0044	not detected	0.035
Capsicum	Bifenthrin	8	1	0.0073	not detected	0.058
	Chlorothalonil	8	1	0.0006	not detected	0.005
	Dicloran	8	1	0.0005	not detected	0.004
	Dimethoate	8	4	0.0778	not detected	0.301
	Dithiocarbamates	8	2	0.0100	not detected	0.04
	Endosulfan -a	8	2	0.0040	not detected	0.022
	Endosulfan -b	8	2	0.0074	not detected	0.048
	Endosulfan sulphate	8	1	0.0024	not detected	0.019
	Iprodione	8	1	0.0113	not detected	0.090
	Procymidone	8	2	0.0314	not detected	0.220
	Propham	8	1	0.0081	not detected	0.065
	Quintozene	8	1	0.0010	not detected	0.008
Carbonated drink		8	0	no agricultural compound residues detected		
Carrot	Azinphos-methyl	8	1	0.0014	not detected	0.011
	DDE -4,4’	8	1	0.0001	not detected	0.001
	Dithiocarbamates	8	4	0.0088	not detected	0.03
	Linuron	8	1	0.0040	not detected	0.032
	Phorate sulphoxide	8	2	0.0033	not detected	0.013
	Phorate sulphone	8	2	0.0086	not detected	0.061
	Procymidone	8	1	0.0019	not detected	0.015
Celery	Chlorothalonil	8	7	0.0320	not detected	0.175
	Diazinon	8	2	0.0245	not detected	0.135
	Difenoconazole, cis	8	2	0.0040	not detected	0.025
	Difenoconazole, trans	8	2	0.0075	not detected	0.046
	Dithiocarbamates	8	6	0.0325	not detected	0.10
	Permethrin-cis	8	1	0.0005	not detected	0.004
	Permethrin-trans	8	1	0.0003	not detected	0.002
	Pirimicarb	8	1	0.0003	not detected	0.002
	Pirimiphos-methyl	8	1	0.0142	not detected	0.114
	Procymidone	8	1	0.0004	not detected	0.003
	Propazine	8	1	0.0015	not detected	0.012
Cheese	DDE -4,4’	8	8	0.0081	0.006	0.013
	Diphenylamine	8	8	0.0030	0.003	0.003
Chicken	Chlorpyriphos-methyl	8	2	0.0023	not detected	0.012
	DDE -4,4’	8	3	0.0033	not detected	0.017
	Ethoxyquin	8	5	0.0093	not detected	0.042
	Pirimiphos-methyl	8	3	0.0065	not detected	0.024
Chicken takeaway	Chlorpyriphos-methyl	8	2	0.0013	not detected	0.008
	DDE -4,4’	8	2	0.0015	not detected	0.009
	Ethoxyquin	8	8	0.0584	0.017	0.121
	Piperonyl butoxide	8	1	0.0013	not detected	0.010
	Pirimiphos-methyl	8	4	0.0016	not detected	0.005
	Sethoxydim	8	1	0.0090	not detected	0.072

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Chinese dish	Diphenylamine	8	2	0.0006	not detected	0.003
	Piperonyl butoxide	8	1	0.0076	not detected	0.061
	Pirimiphos-methyl	8	2	0.0024	not detected	0.016
	Procymidone	8	2	0.0019	not detected	0.010
Chocolate beverage		8	0	no agricultural compound residues detected		
Chocolate, plain milk	DDE -4,4′	8	4	0.0036	not detected	0.015
Coffee beans, ground		8	0	no agricultural compound residues detected		
Coffee, instant		8	0	no agricultural compound residues detected		
Confectionery		8	0	no agricultural compound residues detected		
Corn, canned	Dithiocarbamates	8	1	0.0013	not detected	0.01
Corned beef	DDE -4,4′	8	6	0.0036	not detected	0.011
	Ethoxyquin	8	1	0.0008	not detected	0.007
Cornflakes		8	0	no agricultural compound residues detected		
Courgette	DDD-4,4′	8	2	0.0004	not detected	0.002
	DDD-2,4′	8	2	0.0006	not detected	0.003
	DDE -4,4′	8	2	0.0044	not detected	0.030
	Dieldrin	8	1	0.0023	not detected	0.018
	Dimethoate	8	4	0.6854	not detected	2.350
	Dithiocarbamates	8	1	0.0013	not detected	0.01
	Endosulfan -a	8	1	0.0014	not detected	0.011
	Endosulfan sulphate	8	4	0.0063	not detected	0.034
	Omethoate	8	4	0.0441	not detected	0.162
	Pirimicarb	8	2	0.0131	not detected	0.082
Cream	DDE -4,4′	8	8	0.0155	0.002	0.041
	Diphenylamine	8	8	0.0045	0.002	0.009
	Malathion	8	1	0.0014	not detected	0.011
Cucumber	Azoxystrobin	8	2	0.0016	not detected	0.009
	Chlorothalonil	8	1	0.0030	not detected	0.024
	Dimethoate	8	1	0.0376	not detected	0.301
	Endosulfan -a	8	1	0.0026	not detected	0.021
	Endosulfan -b	8	1	0.0021	not detected	0.017
	Endosulfan sulphate	8	1	0.0025	not detected	0.020
	Metalaxyl	8	3	0.0160	not detected	0.090
	Omethoate	8	1	0.0014	not detected	0.011
	Penconazole	8	1	0.0010	not detected	0.008
	Permethrin-cis	8	1	0.0004	not detected	0.003
	Permethrin-trans	8	1	0.0005	not detected	0.004
	Pirimicarb	8	1	0.0011	not detected	0.009
	Pirimiphos-methyl	8	1	0.0005	not detected	0.004
	Pyrazophos	8	1	0.0003	not detected	0.002
	Terbutylazine	8	1	0.0004	not detected	0.003
	Triademenol	8	2	0.0008	not detected	0.004
Dairy dessert	DDE -4,4′	8	1	0.0004	not detected	0.003
Egg	DDE -4,4′	8	4	0.0024	not detected	0.008
	Ethoxyquin	8	6	0.0112	not detected	0.022
Fish fingers	Pirimiphos-methyl	8	8	0.0409	0.014	0.053
Fish, battered	Chlorpyriphos-methyl	8	1	0.0004	not detected	0.003
	DDE -4,4′	8	1	0.0001	not detected	0.001
	Fenitrothion	8	1	0.0024	not detected	0.019
	Pirimiphos-methyl	8	4	0.0071	not detected	0.021
	Propham	8	2	0.0043	not detected	0.024

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Fish, canned	DDD-4,4′	8	1	0.0035	not detected	0.028
	DDD-2,4′	8	1	0.0010	not detected	0.008
	DDE -4,4′	8	2	0.0026	not detected	0.019
Fish, fresh	DDD-4,4′	8	1	0.0006	not detected	0.005
	DDE -4,4′	8	4	0.0020	not detected	0.011
	Ethoxyquin	8	1	0.0875	not detected	0.700
Fruit drink		8	0	no agricultural compound residues detected		
Grapes	Azoxystrobin	8	1	0.0030	not detected	0.024
	Captan	8	2	0.0086	not detected	0.056
	Carbaryl	8	1	0.0044	not detected	0.035
	Chlorpyriphos	8	2	0.0193	not detected	0.143
	Cyprodinil	8	2	0.0333	not detected	0.239
	Dicofol	8	1	0.0003	not detected	0.002
	Dithiocarbamates	8	2	0.0400	not detected	0.25
	Fludioxinil	8	1	0.0011	not detected	0.009
	Iprodione	8	2	0.0221	not detected	0.100
	Kresoxim-methyl	8	1	0.0008	not detected	0.006
	Prothiophos	8	1	0.0008	not detected	0.006
	Pyrimethanil	8	2	0.0008	not detected	0.004
	Tebuconazole	8	2	0.0041	not detected	0.023
	Tebufenpyrad	8	2	0.0041	not detected	0.023
	Triademefon	8	1	0.0005	not detected	0.004
	Triademenol	8	1	0.0019	not detected	0.016
Ham	DDE -4,4′	8	1	0.0013	not detected	0.010
Hamburger, plain	Chlorpyriphos	8	1	0.0015	not detected	0.012
	Chlorpyriphos-methyl	8	2	0.0005	not detected	0.002
	DDE -4,4′	8	4	0.0013	not detected	0.004
	Permethrin-cis	8	1	0.0005	not detected	0.004
	Permethrin-trans	8	1	0.0008	not detected	0.006
	Pirimiphos-methyl	8	7	0.0181	not detected	0.045
Honey	Bifenthrin	8	3	0.0026	not detected	0.009
Ice-cream	DDE -4,4′	8	5	0.0046	not detected	0.011
	Diphenylamine	8	1	0.0001	not detected	0.001
Infant & Follow on formula		8	0	no agricultural compound residues detected		
Infant weaning food, cereal based	Carbaryl	8	1	0.0004	not detected	0.003
	Diphenylamine	8	4	0.0054	not detected	0.020
	Iprodione	8	4	0.0260	not detected	0.115
Infant weaning food, custard/fruit dish	Diphenylamine	8	1	0.0006	not detected	0.005
Infant weaning food, savoury		8	0	no agricultural compound residues detected		
Jam	Carbaryl	8	1	0.0350	not detected	0.280
	Chlorpyriphos	8	1	0.0006	not detected	0.005
	Cyprodinil	8	1	0.0014	not detected	0.011
	Diazinon	8	1	0.0026	not detected	0.021
	Fenvalerate	8	1	0.0015	not detected	0.012
	Fludioxinil	8	1	0.0010	not detected	0.008
	Iprodione	8	1	0.0036	not detected	0.029
Kiwifruit	Vinclozolin	8	4	0.0034	not detected	0.011
Kumara	Dicloran	8	4	0.0576	not detected	0.260

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Lamb/mutton	DDE -4,4′	8	5	0.0055	not detected	0.014
	Diphenylamine	8	1	0.0004	not detected	0.003
	Piperonyl butoxide	8	1	0.0004	not detected	0.003
Lambs liver		8	0	no agricultural compound residues detected		
Lettuce	Carbaryl	8	1	0.0125	not detected	0.100
	Chlorothalonil	8	1	0.0013	not detected	0.010
	Dithiocarbamates	8	3	0.0125	not detected	0.06
	Pirimicarb	8	2	0.1354	not detected	0.977
	Procymidone	8	2	0.0019	not detected	0.010
Margarine		8	0	no agricultural compound residues detected		
Meat pie	Chlorpyriphos	8	1	0.0016	not detected	0.013
	Chlorpyriphos-methyl	8	1	0.0003	not detected	0.002
	DDE -4,4′	8	4	0.0013	not detected	0.005
	Diazinon	8	1	0.0004	not detected	0.003
	Fenitrothion	8	4	0.0080	not detected	0.033
	Pirimiphos-methyl	8	7	0.0249	not detected	0.058
	Propoxur	8	1	0.0021	not detected	0.017
Melons	Dimethoate	8	3	0.0655	not detected	0.288
	Procymidone	8	1	0.0003	not detected	0.002
Milk, 0.5% fat		8	0	no agricultural compound residues detected		
Milk, 3.25% fat	DDE -4,4′	8	2	0.0004	not detected	0.002
	Tetrachlorvinphos	8	1	0.0011	not detected	0.009
Milk, flavoured	DDE -4,4′	8	1	0.0001	not detected	0.001
Muesli	Chlorpyriphos-methyl	8	2	0.0181	not detected	0.117
	Cyprodinil	8	1	0.0009	not detected	0.007
	Dichlofluanid	8	1	0.0179	not detected	0.143
	Dicofol	8	1	0.0103	not detected	0.083
	Fenitrothion	8	2	0.0103	not detected	0.047
	Iprodione	8	2	0.0075	not detected	0.041
	Malathion	8	1	0.0046	not detected	0.037
	Piperonyl butoxide	8	1	0.0009	not detected	0.007
	Pirimiphos-methyl	8	5	0.0243	not detected	0.153
	Procymidone	8	2	0.0120	not detected	0.059
	Propargite 1+2	8	1	0.0020	not detected	0.016
	Pyrimethanil	8	1	0.0019	not detected	0.015
Muffin	Chlorpyriphos-methyl	8	7	0.0225	not detected	0.063
	DDE -4,4′	8	2	0.0005	not detected	0.002
	Dicofol	8	1	0.0005	not detected	0.004
	Fenitrothion	8	4	0.0139	not detected	0.066
	Piperonyl butoxide	8	1	0.0059	not detected	0.047
	Pirimiphos-methyl	8	5	0.0151	not detected	0.038
	Procymidone	8	1	0.0018	not detected	0.014
	Propargite 1+2	8	1	0.0023	not detected	0.018
Mushrooms	Dicloran	8	1	0.0004	not detected	0.003
	Dithiocarbamates	8	2	0.0089	not detected	0.06
	Piperonyl butoxide	8	1	0.0009	not detected	0.007
Mussels		8	0	no agricultural compound residues detected		
Nectarine	Captan	8	4	0.0333	not detected	0.120
	Carbaryl	8	4	0.1123	not detected	0.450
	Dithiocarbamates	8	2	0.0258	not detected	0.12
	Iprodione	8	4	0.4675	not detected	1.800
	Phosmet	8	2	0.0888	not detected	0.675
	Procymidone	8	1	0.0094	not detected	0.075
Noodles, instant	Chlorpyriphos-methyl	8	2	0.0038	not detected	0.017

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Oats, rolled	Fenitrothion	8	2	0.0056	not detected	0.034
Oil	Diflufenican	8	1	0.0018	not detected	0.014
	Endosulfan sulphate	8	5	0.0398	not detected	0.145
	Procymidone	8	1	0.0071	not detected	0.057
	Simazine	8	2	0.0375	not detected	0.290
	Terbufos	8	4	0.0046	not detected	0.011
	Terbutylazine	8	1	0.0143	not detected	0.114
Onion	Dithiocarbamates	8	6	0.0188	not detected	0.04
Orange		8	0	no agricultural compound residues detected		
Orange juice		8	0	no agricultural compound residues detected		
Oysters		8	0	no agricultural compound residues detected		
Pasta, dried	Chlorpyriphos	8	1	0.0005	not detected	0.004
	Chlorpyriphos-methyl	8	2	0.0074	not detected	0.048
	Pirimiphos-methyl	8	2	0.0041	not detected	0.032
Peaches, canned	Carbaryl	8	3	0.0363	not detected	0.180
	Iprodione	8	3	0.0055	not detected	0.019
	Procymidone	8	1	0.0033	not detected	0.026
	Propiconazole-cis	8	1	0.0003	not detected	0.002
	Propiconazole-trans	8	1	0.0004	not detected	0.003
Peanut butter	Acetochlor	8	1	0.0011	not detected	0.009
	BHC-b	8	1	0.0014	not detected	0.011
	DDE -4,4’	8	1	0.0003	not detected	0.002
	Diphenylamine	8	5	0.0029	not detected	0.006
	Endosulfan -a	8	1	0.0121	not detected	0.097
	Endosulfan -b	8	1	0.0024	not detected	0.019
	Piperonyl butoxide	8	1	0.0049	not detected	0.039
	Pirimiphos-methyl	8	5	0.0088	not detected	0.029
Peanuts, whole	BHC-a	8	1	0.0008	not detected	0.006
	BHC-b	8	1	0.0025	not detected	0.020
	Endosulfan sulphate	8	1	0.0016	not detected	0.013
	Phorate sulphone	8	1	0.0050	not detected	0.040
	Pirimiphos-methyl	8	2	0.0058	not detected	0.025
	Quintozene	8	1	0.0005	not detected	0.004
Pear	Captan	8	6	0.0591	not detected	0.383
	Dichlofluanid	8	2	0.0156	not detected	0.113
	Diphenylamine	8	4	0.3439	not detected	1.140
	Dithiocarbamates	8	3	0.0125	not detected	0.04
	Endosulfan sulphate	8	1	0.0004	not detected	0.003
	Indoxacarb	8	3	0.0025	not detected	0.012
	Iprodione	8	4	0.1448	not detected	0.386
	Tolylfluanid	8	1	0.0399	not detected	0.319
Peas	Dithiocarbamates	8	4	0.0106	not detected	0.03
Pineapple, canned		8	0	no agricultural compound residues detected		
Pizza	Chlorpyriphos	8	1	0.0014	not detected	0.011
	Chlorpyriphos-methyl	8	2	0.0028	not detected	0.017
	DDE -4,4’	8	4	0.0026	not detected	0.007
	Fenitrothion	8	5	0.0345	not detected	0.161
	Pirimiphos-methyl	8	8	0.0404	0.009	0.080
Pork chop	DDE -4,4’	8	4	0.0053	not detected	0.018
Potato crisps	Chlorpropham	8	1	0.0048	not detected	0.038
	Propham	8	4	0.2251	not detected	0.808
Potato, hot chips	Chlorpropham	8	2	0.0191	not detected	0.080
	Propham	8	2	0.0454	not detected	0.353

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Potatoes, peeled	Pencycuron	8	1	0.0016	not detected	0.013
	Propham	8	4	0.1293	not detected	0.479
Potatoes, with skin	Phorate sulphoxide	8	1	0.0028	not detected	0.022
	Phorate sulphone	8	1	0.0010	not detected	0.008
	Propham	8	4	0.2793	not detected	1.040
Prunes	Dicofol	8	1	0.0008	not detected	0.006
	Dithiocarbamates	8	2	0.0150	not detected	0.11
	Fenvalerate	8	1	0.0023	not detected	0.018
	Propargite 1+2	8	3	0.0328	not detected	0.200
Pumpkin	Dieldrin	8	5	0.0080	not detected	0.023
Raisins/sultanas	Captan	8	1	0.0048	not detected	0.039
	Carbaryl	8	1	0.0183	not detected	0.146
	Chlorpyriphos	8	6	0.0154	not detected	0.064
	Chlorpyriphos-methyl	8	1	0.0013	not detected	0.011
	Cyhalothrin-g	8	1	0.0010	not detected	0.008
	Cyhalothrin-i	8	2	0.0038	not detected	0.020
	Cypermethrin	8	3	0.0264	not detected	0.173
	Cyprodinil	8	2	0.0148	not detected	0.075
	Dicofol	8	3	0.0267	not detected	0.129
	Dithiocarbamates	8	1	0.0063	not detected	0.05
	Fenpropathrin	8	1	0.0055	not detected	0.044
	Fenvalerate	8	1	0.0054	not detected	0.043
	Iprodione	8	7	0.0482	not detected	0.104
	Parathion-methyl	8	1	0.0047	not detected	0.037
	Piperonyl butoxide	8	2	0.0545	not detected	0.373
	Procymidone	8	7	0.0866	not detected	0.260
	Propargite 1+2	8	5	0.0588	not detected	0.187
Rice, white	Piperonyl butoxide	8	1	0.0018	not detected	0.014
	Pirimiphos-methyl	8	1	0.0030	not detected	0.024
Salad dressing	Endosulfan sulphate	8	2	0.0101	not detected	0.041
	Iprodione	8	1	0.0033	not detected	0.026
Sausages	Chlorpyriphos	8	3	0.0012	not detected	0.004
	Chlorpyriphos-methyl	8	1	0.0003	not detected	0.003
	DDE -4,4’	8	6	0.0097	not detected	0.023
	Ethoxyquin	8	3	0.0046	not detected	0.020
	Fenitrothion	8	1	0.0018	not detected	0.014
	Piperonyl butoxide	8	1	0.0011	not detected	0.009
	Pirimiphos-methyl	8	8	0.0273	0.013	0.047
Silverbeet	DDE -4,4’	8	1	0.0006	not detected	0.005
	Difenoconazole, cis	8	1	0.0025	not detected	0.020
	Difenoconazole, trans	8	1	0.0049	not detected	0.039
	Dithiocarbamates	8	3	0.0963	not detected	0.40
	Propham	8	1	0.0009	not detected	0.007
Snack bars	Chlorpyriphos	8	1	0.0008	not detected	0.006
	Chlorpyriphos-methyl	8	5	0.0185	not detected	0.069
	Cyprodinil	8	1	0.0008	not detected	0.006
	Diphenylamine	8	2	0.0010	not detected	0.004
	Fenitrothion	8	3	0.0090	not detected	0.041
	Iprodione	8	1	0.0058	not detected	0.046
	Pirimiphos-methyl	8	3	0.0060	not detected	0.022
	Procymidone	8	2	0.0159	not detected	0.119

2003/04 NZTDS Food	Agricultural compound detected	No. samples analysed	No. with residues	Mean (mg/kg)	Minimum (mg/kg)	Maximum (mg/kg)
Snacks, flavoured	Chlorpropham	8	1	0.0052	not detected	0.042
	Cypermethrin	8	1	0.0018	not detected	0.014
	Ethoxyquin	8	1	0.0007	not detected	0.005
	Pirimiphos-methyl	8	4	0.0026	not detected	0.010
	Quintozene	8	1	0.0026	not detected	0.021
Soup, chicken		8	0	no agricultural compound residues detected		
Soy milk	Fenitrothion	8	1	0.0004	not detected	0.003
Spaghetti in sauce, canned		8	0	no agricultural compound residues detected		
Strawberries	Captan	8	4	0.9405	not detected	2.740
	Carbaryl	8	1	0.0489	not detected	0.391
	Dithiocarbamates	8	2	0.0049	not detected	0.02
	Iprodione	8	4	0.1609	not detected	0.630
	Pyrimethanil	8	3	0.0630	not detected	0.465
	Tolylfluanid	8	3	0.6120	not detected	2.420
Sugar		8	0	no agricultural compound residues detected		
Taro	Dithiocarbamates	8	1	0.0038	not detected	0.03
Tea		8	0	no agricultural compound residues detected		
Tomato	Buprofezin	8	1	0.0014	not detected	0.011
	Chlorothalonil	8	1	0.0011	not detected	0.009
	Cyprodinil	8	1	0.0005	not detected	0.004
	Dithiocarbamates	8	3	0.0138	not detected	0.04
	Endosulfan -a	8	4	0.0318	not detected	0.102
	Endosulfan -b	8	4	0.0330	not detected	0.113
	Endosulfan sulphate	8	3	0.0134	not detected	0.060
	Iprodione	8	1	0.0143	not detected	0.114
	Metalaxyl	8	1	0.0015	not detected	0.012
	Permethrin-cis	8	3	0.0056	not detected	0.024
	Permethrin-trans	8	3	0.0056	not detected	0.025
	Pirimiphos-methyl	8	3	0.0278	not detected	0.154
Tomato sauce	Azoxystrobin	8	2	0.0009	not detected	0.004
	Bifenthrin	8	1	0.0003	not detected	0.002
	Dithiocarbamates	8	3	0.0050	not detected	0.02
	Procymidone	8	1	0.0024	not detected	0.019
Tomatoes in juice	Procymidone	8	1	0.0018	not detected	0.014
Water		8	0	no agricultural compound residues detected		
Wheat biscuit cereals	Permethrin-cis	8	1	0.0003	not detected	0.002
	Permethrin-trans	8	1	0.0009	not detected	0.007
	Piperonyl butoxide	8	1	0.0016	not detected	0.013
	Pirimiphos-methyl	8	7	0.0276	not detected	0.091
Wine, still red	Carbaryl	8	1	0.0036	not detected	0.029
	Dichlofluanid	8	1	0.0054	not detected	0.043
	Iprodione	8	7	0.0395	not detected	0.112
	Procymidone	8	3	0.0040	not detected	0.016
	Pyrimethanil	8	4	0.0950	not detected	0.411
Wine, still white	Iprodione	8	7	0.0155	not detected	0.025
	Pyrimethanil	8	3	0.0288	not detected	0.146
	Tebuconazole	8	1	0.0008	not detected	0.006
Yeast extract		8	0	no agricultural compound residues detected		
Yoghurt	Carbaryl	8	1	0.0035	not detected	0.028
	DDE -4,4′	8	1	0.0003	not detected	0.002
	Iprodione	8	2	0.0036	not detected	0.025

APPENDIX 8: CONTAMINANT ELEMENTS – ARSENIC (TOTAL), CADMIUM, LEAD AND MERCURY (TOTAL) IN THE 2003/04 NZTDS

Almost all foods in the 2003/04 NZTDS had eight different samples analysed. Generally, foods were analysed as composites, with each composite representing a separate brand or region in either season one or two. Each composite was derived by combining multiple purchases of each individual brand, or different region, for that food.

The main goal of the 2003/04 NZTDS is to estimate dietary exposures to selected chemical residues, contaminant and nutrient elements in the New Zealand food supply, compare these with internationally recognised acceptable exposures or levels, and identify trends in New Zealand over time. To this end, a key characteristic of TDSs is that foods are analysed as for normal consumption (ie. meat cooked, apple cored; fuller details in **Appendix 1**). Contaminant concentrations reported are thus on a 'sample as consumed and as received basis', that is, at normal moisture content after preparation for consumption.

In recording the minimum and maximum concentrations for each food, normal international convention has been followed for 'not detected' results, namely the result is reported as 'less than the limit of detection' (LOD) (ie <0.0213 mg/kg means not detected, down to a limit of detection of 0.0213 mg/kg). It should also be noted that as the limits of detection are derived from the standard deviation of blanks from analytical runs corrected for final digest volume and sample weight taken according to international protocol (Keith et al, 1983), consequently, these varied over the course of the project.

When estimating an arithmetic mean contaminant concentration, a 'not detected' result was allocated the value of half the limit of detection (ND-LOD/2) in **Tables A 8.1-A 8.4**. This maintains consistency of approach with previous NZTDSs and with the approach recommended by the 1995 Global Environmental Monitoring System/Food Euro workshop for determining means in commodity food surveys (WHO, 1994, 1995). For results above the LOD, the actual result generated by the ICP-MS has been used for determining arithmetic means. For the purposes of dietary intake estimates, lower and upper bound mean concentrations were also used, with 'not detected' results assigned to zero and the LOD, respectively.

A few foods were not analysed in the 2003/04 NZTDS because previous experience indicated levels would be non-detectable. These are indicated by 'NA' in the 'number of samples analysed' column. They relate only to total mercury for high fat foods or dry products such as biscuits, breads, butter, cheese etc. For effective dietary exposure assessment and comparison of dietary exposures with other total diet studies, a best estimate of dietary intake across all foods is desirable, so foods not analysed in the 2003/04 NZTDS were separately assigned a mean value based on previous NZTDSs or other New Zealand data (Vannoort et al, 2000, for mercury).

Mean concentrations would normally be rounded, but the mean is an intermediate in the calculation of the estimated dietary exposure, so rounding has been left to the final calculated figure.

Table A 8.1: Arsenic content (mg/kg) in foods of the 2003/04 NZTDS

ARSENIC (total) content (mg/kg) of foods in 2003/04 NZTDS	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	8	8	0.0010	< 0.002	< 0.002
Apple-based juice	8	1	0.0027	< 0.001	0.007
Apricot, canned	8	8	0.0010	< 0.002	< 0.002
Avocado	8	5	0.0016	< 0.002	0.004
Bacon	8	0	0.0058	0.004	0.008
Banana	8	8	0.0010	< 0.002	< 0.002
Beans	8	8	0.0010	< 0.002	< 0.002
Beans, baked, canned	8	8	0.0010	< 0.002	< 0.002
Beef, mince	8	0	0.0056	0.003	0.009
Beef, rump	8	0	0.0066	0.003	0.011
Beer	8	5	0.0009	< 0.001	0.003
Beetroot, canned	8	8	0.0010	< 0.002	< 0.002
Biscuit, chocolate	8	8	0.0050	< 0.010	< 0.010
Biscuit, cracker	8	5	0.0094	< 0.010	0.02
Biscuits, plain sweet	8	8	0.0050	< 0.010	< 0.010
Bran flake cereal, mixed	8	4	0.0163	< 0.010	0.050
Bread, mixed grain	8	3	0.0061	< 0.005	0.013
Bread, wheatmeal	8	2	0.0121	< 0.005	0.029
Bread, white	8	3	0.0085	< 0.005	0.021
Broccoli/cauliflower	8	8	0.0010	< 0.002	< 0.002
Butter	8	8	0.0050	< 0.010	< 0.010
Cabbage	8	8	0.0010	< 0.002	< 0.002
Caffeinated beverage	8	8	0.0005	< 0.001	< 0.001
Cake	8	7	0.0032	< 0.005	0.008
Capsicum	8	8	0.0010	< 0.002	< 0.002
Carbonated drink	8	8	0.0005	< 0.001	< 0.001
Carrot	8	8	0.0010	< 0.002	< 0.002
Celery	8	6	0.0016	< 0.002	0.004
Cheese	8	8	0.0050	< 0.010	< 0.010
Chicken	8	0	0.0100	0.006	0.015
Chicken takeaway	8	1	0.0045	< 0.002	0.008
Chinese dish	8	0	0.0075	0.004	0.013
Chocolate beverage	8	6	0.0006	< 0.001	0.001
Chocolate, plain milk	8	8	0.0050	< 0.010	< 0.010
Coffee beans, ground	8	8	0.0008	< 0.001	< 0.001
Coffee, instant	8	8	0.0005	< 0.001	< 0.001
Confectionery	8	8	0.0050	< 0.010	< 0.010
Corn, canned	8	7	0.0011	< 0.002	0.002
Corned beef	8	0	0.0044	0.003	0.006
Cornflakes	8	8	0.0050	< 0.010	< 0.010
Courgette	8	8	0.0010	< 0.002	< 0.002
Cream	8	8	0.0010	< 0.002	< 0.002
Cucumber	8	6	0.0015	< 0.002	0.004
Dairy dessert	8	8	0.0010	< 0.002	< 0.002
Egg	8	0	0.0086	0.007	0.010
Fish fingers	8	0	0.7619	0.435	1.490
Fish, battered	8	0	2.6625	0.463	10.960
Fish, canned	8	0	0.7038	0.342	1.090

ARSENIC (total) content (mg/kg) of foods in 2003/04 NZTDS	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Fish, fresh	8	0	3.1588	2.080	4.140
Fruit drink	8	8	0.0005	< 0.001	< 0.001
Grapes	8	2	0.0038	0.002	0.011
Ham	8	0	0.0063	0.003	0.008
Hamburger, plain	8	0	0.0110	0.006	0.015
Honey	8	8	0.0050	< 0.010	< 0.010
Ice-cream	8	8	0.0010	< 0.002	< 0.002
Infant & Follow on formula	8	8	0.0005	< 0.001	< 0.001
Infant weaning food, cereal based	8	0	0.0111	0.002	0.021
Infant weaning food, custard/fruit dish	8	0	0.0209	0.005	0.070
Infant weaning food, savoury	8	2	0.0123	< 0.002	0.042
Jam	8	8	0.0050	< 0.010	< 0.010
Kiwifruit	8	8	0.0010	< 0.002	< 0.002
Kumara	8	8	0.0010	< 0.002	< 0.002
Lamb/mutton	8	5	0.0016	< 0.002	0.003
Lambs liver	8	0	0.0073	0.003	0.017
Lettuce	8	8	0.0010	< 0.002	< 0.002
Margarine	8	8	0.0050	< 0.010	< 0.010
Meat pie	8	3	0.0031	< 0.002	0.007
Melons	8	8	0.0010	< 0.002	< 0.002
Milk, 0.5% fat	8	8	0.0005	< 0.001	< 0.001
Milk, 3.25% fat	8	8	0.0005	< 0.001	< 0.001
Milk, flavoured	8	8	0.0005	< 0.001	< 0.001
Muesli	8	5	0.0069	< 0.010	0.010
Muffin	8	6	0.0036	< 0.005	0.009
Mushrooms	8	0	0.0899	0.014	0.149
Mussels	8	0	1.9675	1.530	2.750
Nectarine	8	6	0.0018	< 0.002	0.005
Noodles, instant	8	4	0.0030	< 0.002	0.007
Oats, rolled	8	5	0.0020	< 0.002	0.004
Oil	8	7	0.0069	< 0.010	0.020
Onion	8	7	0.0011	< 0.002	0.002
Orange	8	7	0.0011	< 0.002	0.002
Orange juice	8	8	0.0005	< 0.001	< 0.001
Oysters	8	0	1.9163	1.400	2.830
Pasta, dried	8	4	0.0028	< 0.002	0.010
Peaches, canned	8	6	0.0013	< 0.002	0.002
Peanut butter	8	6	0.0075	< 0.010	0.020
Peanuts, whole	8	8	0.0050	< 0.010	< 0.010
Pear	8	7	0.0014	< 0.002	0.004
Peas	8	8	0.0010	< 0.002	< 0.002
Pineapple, canned	8	8	0.0010	< 0.002	< 0.002
Pizza	8	0	0.0163	0.007	0.057
Pork chop	8	2	0.0045	< 0.002	0.008
Potato crisps	8	8	0.0050	< 0.010	< 0.010
Potato, hot chips	8	6	0.0028	< 0.002	0.012
Potatoes, peeled	8	6	0.0016	< 0.002	0.004
Potatoes, with skin	8	4	0.0020	< 0.002	0.005
Prunes	8	3	0.0028	< 0.002	0.005

ARSENIC (total) content (mg/kg) of foods in 2003/04 NZTDS	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Pumpkin	8	8	0.0010	< 0.002	< 0.002
Raisins/sultanas	8	0	0.0181	0.007	0.031
Rice, white	8	0	0.0614	0.031	0.103
Salad dressing	8	8	0.0050	< 0.010	< 0.010
Sausages	8	0	0.0038	0.002	0.007
Silverbeet	8	6	0.0019	< 0.002	0.006
Snack bars	8	4	0.0113	< 0.010	0.020
Snacks, flavoured	8	6	0.0063	< 0.010	0.010
Soup, chicken	8	8	0.0010	< 0.002	< 0.002
Soy milk	8	0	0.0191	0.002	0.094
Spaghetti in sauce, canned	8	7	0.0049	< 0.002	0.032
Strawberries	7	2	0.0024	< 0.002	0.005
Sugar	8	8	0.0050	< 0.010	< 0.010
Taro	8	6	0.0020	< 0.002	0.007
Tea	8	8	0.0005	< 0.001	< 0.001
Tomato	8	8	0.0010	< 0.002	< 0.002
Tomato sauce	8	8	0.0010	< 0.002	< 0.002
Tomatoes in juice	8	7	0.0011	< 0.002	0.002
Water	8	6	0.0009	< 0.001	0.002
Wheat biscuit cereals	8	7	0.0069	< 0.010	0.020
Wine, still red	8	0	0.0076	0.004	0.016
Wine, still white	8	0	0.0068	0.004	0.011
Yeast extract	6	0	0.1578	0.066	0.237
Yoghurt	8	8	0.0010	< 0.002	< 0.002

Table A 8.2: Cadmium content (mg/kg) of 2003/04 NZTDS foods

CADMIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	8	8	0.0002	< 0.0003	< 0.0004
Apple-based juice	8	2	0.0003	< 0.0002	0.0006
Apricot, canned	8	0	0.0010	0.0005	0.0019
Avocado	8	0	0.0226	0.0061	0.0362
Bacon	8	5	0.0003	< 0.0004	0.0005
Banana	8	4	0.0018	< 0.0004	0.0084
Beans	8	1	0.0008	< 0.0004	0.0014
Beans, baked, canned	8	0	0.0048	0.0037	0.0057
Beef, mince	8	6	0.0004	< 0.0004	0.0012
Beef, rump	8	6	0.0003	< 0.0004	0.0006
Beer	8	4	0.0002	< 0.0002	0.0004
Beetroot, canned	8	0	0.0117	0.0085	0.0178
Biscuit, chocolate	8	0	0.0294	0.0090	0.0460
Biscuit, cracker	8	0	0.0116	0.0090	0.0140
Biscuits, plain sweet	8	0	0.0119	0.0050	0.0210
Bran flake cereal, mixed	8	1	0.0201	< 0.0020	0.0580
Bread, mixed grain	8	0	0.0188	0.0117	0.0328
Bread, wheatmeal	8	0	0.0181	0.0080	0.0270
Bread, white	8	0	0.0148	0.0060	0.0210
Broccoli/cauliflower	8	0	0.0055	0.0034	0.0094
Butter	8	8	0.0010	< 0.0020	< 0.0020
Cabbage	8	0	0.0034	0.0016	0.0070
Caffeinated beverage	8	8	0.0001	< 0.0002	< 0.0002
Cake	8	0	0.0053	0.0030	0.0070
Capsicum	8	1	0.0046	< 0.0004	0.0091
Carbonated drink	8	8	0.0001	< 0.0002	< 0.0002
Carrot	8	0	0.0271	0.0086	0.0459
Celery	8	0	0.0215	0.0064	0.0446
Cheese	8	7	0.0011	< 0.0020	0.0020
Chicken	8	4	0.0026	< 0.0004	0.0109
Chicken takeaway	8	0	0.0030	0.0018	0.0041
Chinese dish	8	0	0.0054	0.0015	0.0098
Chocolate beverage	8	0	0.0034	0.0010	0.0071
Chocolate, plain milk	8	0	0.0243	0.0080	0.0410
Coffee beans, ground	8	8	0.0002	< 0.0002	< 0.0004
Coffee, instant	8	8	0.0001	< 0.0002	< 0.0002
Confectionery	8	8	0.0010	< 0.0020	< 0.002
Corn, canned	8	2	0.0010	< 0.0004	0.0028
Corned beef	8	0	0.0016	0.0012	0.0025
Cornflakes	8	7	0.0013	< 0.0020	0.0030
Courgette	8	0	0.0028	0.0007	0.0058
Cream	8	8	0.0002	< 0.0004	< 0.0005

CADMIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Cucumber	8	6	0.0002	< 0.0002	0.0004
Dairy dessert	8	5	0.0008	< 0.0004	0.0017
Egg	8	7	0.0003	< 0.0004	0.0012
Fish fingers	8	0	0.0070	0.0044	0.0129
Fish, battered	8	0	0.0050	0.0029	0.0070
Fish, canned	8	0	0.0109	0.0020	0.0316
Fish, fresh	8	0	0.0017	0.0008	0.0031
Fruit drink	8	4	0.0002	< 0.0002	0.0007
Grapes	8	8	0.0002	< 0.0004	< 0.0004
Ham	8	0	0.0021	0.0017	0.0025
Hamburger, plain	8	0	0.0103	0.0071	0.0123
Honey	8	8	0.0010	< 0.0020	< 0.002
Ice-cream	8	7	0.0004	< 0.0004	0.0017
Infant & Follow on formula	8	6	0.0002	< 0.0002	0.0007
Infant weaning food, cereal based	8	2	0.0012	< 0.0004	0.0026
Infant weaning food, custard/fruit dish	8	2	0.0007	< 0.0004	0.0013
Infant weaning food, savoury	8	0	0.0061	0.0026	0.0097
Jam	8	6	0.0018	< 0.0020	0.0050
Kiwifruit	8	2	0.0003	< 0.0004	0.0007
Kumara	8	0	0.0050	0.0037	0.0071
Lamb/mutton	8	5	0.0003	< 0.0004	0.0006
Lambs liver	8	0	0.1015	0.0237	0.1660
Lettuce	8	0	0.0174	0.0079	0.0296
Margarine	8	8	0.0010	< 0.0020	< 0.0020
Meat pie	8	0	0.0060	0.0019	0.0086
Melons	8	0	0.0036	0.0020	0.0064
Milk, 0.5% fat	8	5	0.0002	< 0.0002	0.0003
Milk, 3.25% fat	8	5	0.0002	< 0.0002	0.0003
Milk, flavoured	8	0	0.0008	0.0003	0.0028
Muesli	8	0	0.0191	0.0090	0.0360
Muffin	8	0	0.0081	0.0050	0.0110
Mushrooms	8	0	0.0045	0.0035	0.0058
Mussels	8	0	0.2108	0.0775	0.3900
Nectarine	8	0	0.0021	0.0009	0.0046
Noodles, instant	8	0	0.0043	0.0014	0.0059
Oats, rolled	8	0	0.0041	0.0018	0.0073
Oil	8	8	0.0010	< 0.0020	< 0.0020
Onion	8	0	0.0183	0.0081	0.0342
Orange	8	8	0.0002	< 0.0002	< 0.0004
Orange juice	8	8	0.0001	< 0.0002	< 0.0002
Oysters	8	0	2.9155	0.6280	5.3200

CADMIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Pasta, dried	8	0	0.0137	0.0048	0.0305
Peaches, canned	8	0	0.0021	0.0010	0.0037
Peanut butter	8	0	0.0388	0.0130	0.0910
Peanuts, whole	8	0	0.0751	0.0280	0.1570
Pear	8	0	0.0026	0.0009	0.0039
Peas	8	0	0.0027	0.0017	0.0050
Pineapple, canned	8	2	0.0024	< 0.0004	0.0152
Pizza	8	0	0.0104	0.0055	0.0201
Pork chop	8	8	0.0002	< 0.0004	< 0.0004
Potato crisps	8	0	0.0686	0.0235	0.1390
Potato, hot chips	8	0	0.0356	0.0150	0.0601
Potatoes, peeled	8	0	0.0226	0.0169	0.0300
Potatoes, with skin	8	0	0.0322	0.0155	0.0444
Prunes	8	0	0.0018	0.0008	0.0045
Pumpkin	8	0	0.0096	0.0057	0.0176
Raisins/sultanas	8	0	0.0010	0.0006	0.0013
Rice, white	8	0	0.0035	0.0019	0.0067
Salad dressing	8	5	0.0023	< 0.0020	0.0050
Sausages	8	0	0.0051	0.0028	0.0112
Silverbeet	8	0	0.0337	0.0102	0.1030
Snack bars	8	0	0.0091	0.0030	0.0180
Snacks, flavoured	8	3	0.0085	< 0.0020	0.0360
Soup, chicken	8	3	0.0005	< 0.0004	0.0010
Soy milk	8	0	0.0022	0.0008	0.0062
Spaghetti in sauce, canned	8	0	0.0080	0.0039	0.0103
Strawberries	7	0	0.0036	0.0015	0.0084
Sugar	8	8	0.0010	< 0.0020	< 0.0020
Taro	8	0	0.0190	0.0057	0.0525
Tea	8	4	0.0004	< 0.0002	0.0019
Tomato	8	1	0.0020	< 0.0004	0.0067
Tomato sauce	8	0	0.0115	0.0059	0.0179
Tomatoes in juice	8	0	0.0090	0.0056	0.0111
Water	8	8	0.000025	< 0.00005	< 0.00005
Wheat biscuit cereals	8	0	0.0338	0.0070	0.0570
Wine, still red	8	0	0.0004	0.0002	0.0007
Wine, still white	8	1	0.0004	< 0.0002	0.0008
Yeast extract	6	0	0.0183	0.0120	0.0340
Yoghurt	8	6	0.0003	< 0.0004	0.0007

Table A 8.3: Lead content (mg/kg) of 2003/04 NZTDS foods

LEAD content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	8	5	0.0019	< 0.002	0.006
Apple-based juice	8	2	0.0019	< 0.001	0.004
Apricot, canned	8	0	0.0621	0.013	0.134
Avocado	8	7	0.0014	< 0.002	0.004
Bacon	8	3	0.0051	< 0.002	0.013
Banana	8	7	0.0011	< 0.002	0.002
Beans	8	3	0.0030	< 0.002	0.007
Beans, baked, canned	8	1	0.0026	< 0.002	0.004
Beef, mince	8	2	0.0030	< 0.002	0.007
Beef, rump	8	4	0.0035	< 0.002	0.011
Beer	8	7	0.0006	< 0.001	0.001
Beetroot, canned	8	5	0.0016	< 0.002	0.003
Biscuit, chocolate	8	1	0.0256	< 0.010	0.050
Biscuit, cracker	8	7	0.0056	< 0.010	0.010
Biscuits, plain sweet	8	6	0.0075	< 0.010	0.020
Bran flake cereal, mixed	8	3	0.0269	< 0.010	0.100
Bread, mixed grain	8	3	0.0083	< 0.005	0.023
Bread, wheatmeal	8	2	0.0089	< 0.005	0.028
Bread, white	8	4	0.0063	< 0.005	0.016
Broccoli/cauliflower	8	3	0.0025	< 0.002	0.004
Butter	8	8	0.0050	< 0.010	< 0.010
Cabbage	8	6	0.0014	< 0.002	0.003
Caffeinated beverage	8	6	0.0013	< 0.001	0.006
Cake	8	5	0.0049	< 0.005	0.011
Capsicum	8	5	0.0020	< 0.002	0.004
Carbonated drink	8	8	0.0005	< 0.001	< 0.001
Carrot	8	2	0.0044	< 0.002	0.012
Celery	8	4	0.0028	< 0.002	0.006
Cheese	8	8	0.0050	< 0.010	< 0.010
Chicken	8	2	0.0037	< 0.002	0.005
Chicken takeaway	8	0	0.0250	0.004	0.147
Chinese dish	8	0	0.0043	0.003	0.008
Chocolate beverage	8	2	0.0023	< 0.001	0.005
Chocolate, plain milk	8	0	0.0165	0.010	0.027
Coffee beans, ground	8	5	0.0016	< 0.001	0.004
Coffee, instant	8	6	0.0009	< 0.001	0.003
Confectionery	8	7	0.0109	< 0.010	0.052
Corn, canned	8	8	0.0010	< 0.002	< 0.002
Corned beef	8	0	0.0106	0.003	0.048
Cornflakes	8	7	0.0081	< 0.010	0.030
Courgette	8	6	0.0024	< 0.002	0.011
Cream	8	8	0.0010	< 0.002	< 0.002
Cucumber	8	8	0.0008	< 0.001	< 0.002
Dairy dessert	8	8	0.0010	< 0.002	< 0.002
Egg	8	5	0.0018	< 0.002	0.003

LEAD content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Fish fingers	8	4	0.0046	< 0.002	0.019
Fish, battered	8	1	0.0053	< 0.002	0.016
Fish, canned	8	5	0.0023	< 0.002	0.006
Fish, fresh	8	2	0.0079	< 0.002	0.016
Fruit drink	8	8	0.0005	< 0.001	< 0.001
Grapes	8	4	0.0033	< 0.002	0.009
Ham	8	0	0.0055	0.003	0.009
Hamburger, plain	8	0	0.0101	0.003	0.042
Honey	8	0	0.0350	0.02	0.066
Ice-cream	8	7	0.0013	< 0.002	0.003
Infant & Follow on formula	8	6	0.0012	< 0.001	0.005
Infant weaning food, cereal based	8	2	0.0104	< 0.002	0.054
Infant weaning food, custard/fruit dish	8	3	0.0610	< 0.002	0.472 *
Infant weaning food, savoury	8	5	0.0024	< 0.002	0.005
Jam	8	7	0.0056	< 0.010	0.010
Kiwifruit	8	5	0.0025	< 0.001	0.008
Kumara	8	4	0.0026	< 0.002	0.005
Lamb/mutton	8	4	0.0048	< 0.002	0.012
Lambs liver	8	0	0.0268	0.016	0.040
Lettuce	8	5	0.0036	< 0.002	0.014
Margarine	8	8	0.0050	< 0.010	< 0.010
Meat pie	8	0	0.0143	0.002	0.088
Melons	8	5	0.0014	< 0.001	0.003
Milk, 0.5% fat	8	8	0.0005	< 0.001	< 0.001
Milk, 3.25% fat	8	7	0.0006	< 0.001	0.001
Milk, flavoured	8	6	0.0008	< 0.001	0.002
Muesli	8	0	0.0250	0.010	0.070
Muffin	8	1	0.0084	< 0.005	0.018
Mushrooms	8	4	0.0023	< 0.002	0.006
Mussels	8	0	0.1040	0.076	0.139
Nectarine	8	3	0.0031	< 0.001	0.007
Noodles, instant	8	1	0.0144	< 0.002	0.043
Oats, rolled	8	2	0.0096	< 0.002	0.022
Oil	8	8	0.0050	< 0.010	< 0.010
Onion	8	4	0.0025	< 0.002	0.004
Orange	8	4	0.0021	< 0.001	0.005
Orange juice	8	7	0.0009	< 0.001	0.004
Oysters	8	0	0.0561	0.022	0.117
Pasta, dried	8	3	0.0106	< 0.002	0.035
Peaches, canned	8	0	0.0158	0.008	0.024
Peanut butter	8	7	0.0069	< 0.010	0.020
Peanuts, whole	8	7	0.0058	< 0.010	0.011
Pear	8	5	0.0018	< 0.002	0.003
Peas	8	2	0.0029	< 0.002	0.005
Pineapple, canned	8	0	0.0156	0.009	0.027
Pizza	8	0	0.0296	0.004	0.124
Pork chop	8	4	0.0065	< 0.002	0.014
Potato crisps	8	5	0.0088	< 0.010	0.024
Potato, hot chips	8	5	0.0019	< 0.002	0.004

LEAD content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Potatoes, peeled	8	5	0.0031	< 0.002	0.009
Potatoes, with skin	8	4	0.0035	< 0.002	0.009
Prunes	8	1	0.0237	< 0.002	0.083
Pumpkin	8	2	0.0050	< 0.002	0.012
Raisins/sultanas	8	0	0.0235	0.011	0.056
Rice, white	8	4	0.0019	< 0.002	0.003
Salad dressing	8	7	0.0059	< 0.010	0.012
Sausages	8	0	0.0084	0.002	0.018
Silverbeet	8	0	0.0101	0.003	0.020
Snack bars	8	4	0.0105	< 0.010	0.020
Snacks, flavoured	8	6	0.0075	< 0.010	0.020
Soup, chicken	8	3	0.0027	< 0.002	0.005
Soy milk	8	6	0.0008	< 0.001	0.002
Spaghetti in sauce, canned	8	5	0.0021	< 0.002	0.006
Strawberries	7	3	0.0038	< 0.001	0.010
Sugar	8	7	0.0059	< 0.010	0.012
Taro	8	1	0.0075	< 0.002	0.028
Tea	8	6	0.0007	< 0.001	0.001
Tomato	8	4	0.0032	< 0.002	0.007
Tomato sauce	8	0	0.0030	0.002	0.004
Tomatoes in juice	8	1	0.0096	< 0.002	0.018
Water	8	8	0.00005	< 0.0001	< 0.0001
Wheat biscuit cereals	8	4	0.0163	< 0.010	0.040
Wine, still red	8	0	0.0093	0.003	0.025
Wine, still white	8	0	0.0145	0.009	0.021
Yeast extract	6	0	0.0330	0.021	0.045
Yoghurt	8	6	0.0014	< 0.002	0.003

* includes anomalous result due to single lead contamination event

Table A 8.4: Mercury content (mg/kg) of 2003/04 NZTDS foods

MERCURY (total) content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	8	8	0.0010	< 0.002	< 0.002
Apple-based juice	8	8	0.0005	< 0.001	< 0.001
Apricot, canned	8	8	0.0010	< 0.002	< 0.002
Avocado	8	8	0.0010	< 0.002	< 0.002
Bacon	8	5	0.0014	< 0.002	0.002
Banana	8	8	0.0010	< 0.002	< 0.002
Beans	8	8	0.0010	< 0.002	< 0.002
Beans, baked, canned	8	8	0.0010	< 0.002	< 0.002
Beef, mince	8	8	0.0010	< 0.002	< 0.002
Beef, rump	8	8	0.0010	< 0.002	< 0.002
Beer	8	8	0.0005	< 0.001	< 0.001
Beetroot, canned	8	8	0.0010	< 0.002	< 0.002
Biscuit, chocolate	NA	NA	0.0010	0.001	0.001
Biscuit, cracker	NA	NA	0.0010	0.001	0.001
Biscuits, plain sweet	NA	NA	0.0010	0.001	0.001
Bran flake cereal, mixed	NA	NA	0.0010	0.001	0.001
Bread, mixed grain	NA	NA	0.0010	0.001	0.001
Bread, wheatmeal	NA	NA	0.0010	0.001	0.001
Bread, white	NA	NA	0.0010	0.001	0.001
Broccoli/cauliflower	8	8	0.0010	< 0.002	< 0.002
Butter	NA	NA	0.0010	0.001	0.001
Cabbage	8	8	0.0010	< 0.002	< 0.002
Caffeinated beverage	8	8	0.0005	< 0.001	< 0.001
Cake	NA	NA	0.0010	0.001	0.001
Capsicum	8	8	0.0010	< 0.002	< 0.002
Carbonated drink	8	8	0.0005	< 0.001	< 0.001
Carrot	8	8	0.0010	< 0.002	< 0.002
Celery	8	8	0.0010	< 0.002	< 0.002
Cheese	NA	NA	0.0010	0.001	0.001
Chicken	8	8	0.0012	< 0.002	< 0.003
Chicken takeaway	8	8	0.0010	< 0.002	< 0.002
Chinese dish	8	8	0.0010	< 0.002	< 0.002
Chocolate beverage	8	8	0.0005	< 0.001	< 0.001
Chocolate, plain milk	NA	NA	0.0010	0.001	0.001
Coffee beans, ground	8	8	0.0008	< 0.001	< 0.002
Coffee, instant	8	8	0.0005	< 0.001	< 0.001
Confectionery	NA	NA	0.0010	0.001	0.001
Corn, canned	8	8	0.0010	< 0.002	< 0.002
Corned beef	8	8	0.0010	< 0.002	< 0.002
Cornflakes	NA	NA	0.0010	0.001	0.001
Courgette	8	8	0.0010	< 0.002	< 0.002
Cream	NA	NA	0.0010	0.001	0.001
Cucumber	8	8	0.0008	< 0.001	< 0.002
Dairy dessert	8	8	0.0010	< 0.002	< 0.002
Egg	8	5	0.0019	< 0.002	0.004
Fish fingers	8	0	0.0953	0.040	0.138
Fish, battered	8	0	0.2496	0.101	0.852

MERCURY (total) content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Fish, canned	8	0	0.0685	0.027	0.156
Fish, fresh	8	0	0.1693	0.055	0.291
Fruit drink	8	8	0.0005	< 0.001	< 0.001
Grapes	8	8	0.0010	< 0.002	< 0.002
Ham	8	8	0.0010	< 0.002	< 0.002
Hamburger, plain	8	8	0.0010	< 0.002	< 0.002
Honey	NA	NA	0.0010	0.001	0.001
Ice-cream	NA	NA	0.0010	0.001	0.001
Infant & Follow on formula	8	7	0.0006	< 0.001	0.001
Infant weaning food, cereal based	8	8	0.0010	< 0.002	< 0.002
Infant weaning food, custard/ fruit dish	8	8	0.0010	< 0.002	< 0.002
Infant weaning food, savoury	8	8	0.0010	< 0.002	< 0.002
Jam	1	0	0.0010	0.001	0.001
Kiwifruit	8	8	0.0008	< 0.001	< 0.002
Kumara	8	8	0.0010	< 0.002	< 0.002
Lamb/mutton	8	8	0.0010	< 0.002	< 0.002
Lambs liver	8	1	0.0030	< 0.002	0.005
Lettuce	8	8	0.0010	< 0.002	< 0.002
Margarine	NA	NA	0.0010	0.001	0.001
Meat pie	8	8	0.0010	< 0.002	< 0.002
Melons	8	8	0.0008	< 0.001	< 0.002
Milk, 0.5% fat	8	8	0.0005	< 0.001	< 0.001
Milk, 3.25% fat	8	8	0.0005	< 0.001	< 0.001
Milk, flavoured	8	8	0.0005	< 0.001	< 0.001
Muesli	NA	NA	0.0010	0.001	0.001
Muffin	NA	NA	0.0010	0.001	0.001
Mushrooms	8	8	0.0010	< 0.002	< 0.002
Mussels	8	0	0.0189	0.011	0.029
Nectarine	8	8	0.0008	< 0.001	< 0.002
Noodles, instant	8	8	0.0010	< 0.002	< 0.002
Oats, rolled	8	8	0.0010	< 0.002	< 0.002
Oil	NA	NA	0.0010	0.001	0.001
Onion	8	8	0.0010	< 0.002	< 0.002
Orange	8	8	0.0008	< 0.001	< 0.002
Orange juice	8	8	0.0005	< 0.001	< 0.001
Oysters	8	0	0.0113	0.009	0.015
Pasta, dried	8	8	0.0010	< 0.002	< 0.002
Peaches, canned	8	8	0.0010	< 0.002	< 0.002
Peanut butter	NA	NA	0.0010	0.001	0.001
Peanuts, whole	NA	NA	0.0010	0.001	0.001
Pear	8	8	0.0010	< 0.002	< 0.002
Peas	8	8	0.0010	< 0.002	< 0.002
Pineapple, canned	8	7	0.0014	< 0.002	0.004
Pizza	8	7	0.0014	< 0.002	0.004
Pork chop	8	8	0.0010	< 0.002	< 0.002

MERCURY (total) content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Potato crisps	8	8	0.0050	< 0.01	< 0.01
Potato, hot chips	8	8	0.0010	< 0.002	< 0.002
Potatoes, peeled	8	8	0.0010	< 0.002	< 0.002
Potatoes, with skin	8	8	0.0010	< 0.002	< 0.002
Prunes	8	8	0.0010	< 0.002	< 0.002
Pumpkin	8	7	0.0023	< 0.002	0.011
Raisins/sultanas	8	7	0.0013	< 0.002	0.00375
Rice, white	8	8	0.0010	< 0.002	< 0.002
Salad dressing	NA	NA	0.0010	0.001	0.001
Sausages	8	8	0.0010	< 0.002	< 0.002
Silverbeet	8	8	0.0010	< 0.002	< 0.002
Snack bars	NA	NA	0.0010	0.001	0.001
Snacks, flavoured	NA	NA	0.0010	0.001	0.001
Soup, chicken	8	8	0.0011	< 0.002	< 0.003
Soy milk	8	8	0.0005	< 0.001	< 0.001
Spaghetti in sauce, canned	NA	NA	0.0010	0.001	0.001
Strawberries	7	7	0.0007	< 0.001	< 0.002
Sugar	NA	NA	0.0010	0.001	0.001
Taro	8	8	0.0010	< 0.002	< 0.002
Tea	8	8	0.0005	< 0.001	< 0.001
Tomato	8	8	0.0010	< 0.002	< 0.002
Tomato sauce	8	8	0.0010	< 0.002	< 0.002
Tomatoes in juice	8	8	0.0010	< 0.002	< 0.002
Water	8	8	0.000045	< 0.00008	< 0.0001
Wheat biscuit cereals	NA	NA	0.0010	0.001	0.001
Wine, still red	8	8	0.0005	< 0.001	< 0.001
Wine, still white	8	8	0.0005	< 0.001	< 0.001
Yeast extract	NA	NA	0.0010	0.001	0.001
Yoghurt	8	8	0.0010	< 0.002	< 0.002

NA = not analysed. Such foods have been assigned a mean value based on previous NZTDS or other New Zealand data (Vannoort et al, 2000)

APPENDIX 9:
NUTRIENT ELEMENTS – IODINE, IRON, SELENIUM AND SODIUM IN THE 2003/04 NZTDS

Almost all foods in the 2003/04 NZTDS had eight different samples analysed. Generally, foods were analysed as composites, with each composite representing a separate brand or region in either season one or two. Each composite was derived by combining multiple purchases of each individual brand, or different region, for that food.

The main goal of the 2003/04 NZTDS is to estimate dietary exposures to selected chemical residues, contaminant and nutrient elements in the New Zealand food supply, compare these with internationally recognised acceptable exposures or levels, and identify trends in New Zealand over time. To this end, a key characteristic of TDSs is that foods are analysed as for normal consumption (ie. meat cooked, apple cored; fuller details in **Appendix 1**). Nutrient concentrations reported are thus on a 'sample as consumed and as received basis', that is, at normal moisture content after preparation for consumption.

In recording the minimum and maximum concentrations for each food, normal international convention has been followed for 'not detected' results, namely the result is reported as 'less than the limit of detection' (LOD) (ie <0.0213 mg/kg means not detected, down to a limit of detection of 0.0213 mg/kg). It should also be noted that as the limits of detection are derived from the standard deviation of blanks from analytical runs corrected for final digest volume and sample weight taken according to international protocol (Keith et al, 1983), consequently, these varied over the course of the project.

When estimating an arithmetic mean contaminant concentration, a 'not detected' result was allocated the value of half the limit of detection (ND=LOD/2) in **Tables A 9.1-A 9.4**. This maintains consistency of approach with previous NZTDSs and with the approach recommended by the 1995 Global Environmental Monitoring System/Food Euro workshop for determining means in commodity food surveys (WHO, 1995). For results above the LOD, the actual result generated by the ICP-MS has been used for determining arithmetic means. For the purposes of dietary intake estimates, lower and upper bound mean concentrations were also used, with 'not detected' results assigned to zero and the LOD, respectively.

A few foods were not analysed in the 2003/04 NZTDS because previous experience indicated levels would be non-detectable. These are indicated by 'NA' in the 'number of samples analysed' column. They relate only to selenium for the high fat foods margarine, salad dressing and oil. For effective dietary exposure assessment and comparison of dietary exposures with other total diet studies, a best estimate of dietary intake across all foods is desirable, so foods not analysed in the 2003/04 NZTDS were separately assigned a mean value based on previous NZTDSs or other New Zealand data (Vannoort et al, 2000, for selenium).

Mean concentrations would normally be rounded, but the mean is an intermediate in the calculation of the estimated dietary exposure, so rounding has been left to the final calculated figure.

Table A 9.1 : Iodine content (mg/kg) of 2003/04 NZTDS foods

IODINE content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	8	6	0.0020	< 0.002	0.007
Apple-based juice	8	0	0.0089	0.002	0.047
Apricot, canned	8	0	0.0149	0.009	0.024
Avocado	8	8	0.0010	< 0.002	< 0.002
Bacon	8	0	0.0106	0.008	0.014
Banana	8	6	0.0014	< 0.002	0.003
Beans	8	7	0.0014	< 0.002	0.004
Beans, baked, canned	8	0	0.0158	0.011	0.026
Beef, mince	8	0	0.0101	0.005	0.031
Beef, rump	8	0	0.0071	0.004	0.010
Beer	8	2	0.0127	< 0.001	0.046
Beetroot, canned	8	0	0.0225	0.016	0.030
Biscuit, chocolate	8	0	0.0551	0.018	0.173
Biscuit, cracker	8	7	0.0081	< 0.010	0.030
Biscuits, plain sweet	8	7	0.0069	< 0.010	0.020
Bran flake cereal, mixed	8	6	0.0100	< 0.010	0.040
Bread, mixed grain	8	1	0.0116	< 0.005	0.025
Bread, wheatmeal	8	5	0.0048	< 0.005	0.011
Bread, white	8	6	0.0032	< 0.005	0.007
Broccoli/cauliflower	8	7	0.0013	< 0.002	0.003
Butter	8	3	0.0096	< 0.010	0.016
Cabbage	8	8	0.0010	< 0.002	< 0.002
Caffeinated beverage	8	4	0.0013	< 0.001	0.003
Cake	8	0	0.1300	0.097	0.206
Capsicum	8	8	0.0010	< 0.002	< 0.002
Carbonated drink	8	2	0.0020	< 0.001	0.005
Carrot	8	3	0.0044	< 0.002	0.018
Celery	8	2	0.0095	< 0.002	0.044
Cheese	8	0	0.0625	0.050	0.070
Chicken	8	0	0.0150	0.003	0.043
Chicken takeaway	8	0	0.0316	0.004	0.116
Chinese dish	8	0	0.0453	0.008	0.240
Chocolate beverage	8	2	0.0133	< 0.001	0.031
Chocolate, plain milk	8	0	0.1525	0.070	0.510
Coffee beans, ground	8	8	0.0008	< 0.001	< 0.002
Coffee, instant	8	6	0.0006	< 0.001	0.001
Confectionery	8	6	0.0075	< 0.010	0.020
Corn, canned	8	0	0.0081	0.005	0.012
Corned beef	8	0	0.0250	0.015	0.043
Cornflakes	8	7	0.0069	< 0.010	0.020
Courgette	8	6	0.0015	< 0.002	0.004
Cream	8	0	0.0609	0.028	0.182
Cucumber	8	7	0.0014	< 0.002	0.004
Dairy dessert	8	0	0.0665	0.045	0.093
Egg	8	0	0.5192	0.432	0.690
Fish fingers	8	0	0.0319	0.020	0.045
Fish, battered	8	0	0.1658	0.025	0.456

IODINE content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Fish, canned	8	0	0.1299	0.078	0.213
Fish, fresh	8	0	0.2159	0.117	0.372
Fruit drink	8	7	0.0007	< 0.001	0.002
Grapes	8	2	0.0049	< 0.002	0.019
Ham	8	0	0.0371	0.023	0.056
Hamburger, plain	8	0	0.0233	0.005	0.082
Honey	8	7	0.0056	< 0.010	0.010
Ice-cream	8	0	0.0680	0.043	0.117
Infant & Follow on formula	8	0	0.0786	0.030	0.109
Infant weaning food, cereal based	8	0	0.0249	0.004	0.061
Infant weaning food, custard/fruit dish	8	0	0.0614	0.006	0.112
Infant weaning food, savoury	8	2	0.0195	< 0.002	0.062
Jam	8	8	0.0050	< 0.010	< 0.010
Kiwifruit	8	8	0.0010	< 0.002	< 0.002
Kumara	8	4	0.0029	< 0.002	0.010
Lamb/mutton	8	0	0.0323	0.006	0.175
Lambs liver	8	0	0.0684	0.048	0.151
Lettuce	8	4	0.0068	< 0.002	0.040
Margarine	8	8	0.0050	< 0.010	< 0.010
Meat pie	8	0	0.0076	0.004	0.011
Melons	8	8	0.0010	< 0.002	< 0.002
Milk, 0.5% fat	8	0	0.0963	0.036	0.312
Milk, 3.25% fat	8	0	0.0858	0.041	0.235
Milk, flavoured	8	0	0.0596	0.042	0.101
Muesli	8	5	0.0106	< 0.010	0.020
Muffin	8	0	0.0866	0.056	0.146
Mushrooms	8	4	0.0028	< 0.002	0.008
Mussels	8	0	1.5325	1.010	3.340
Nectarine	8	8	0.0010	< 0.002	< 0.002
Noodles, instant	8	1	0.0675	< 0.002	0.186
Oats, rolled	8	7	0.0015	< 0.002	0.005
Oil	8	8	0.0050	< 0.010	< 0.010
Onion	8	1	0.0036	< 0.002	0.008
Orange	8	7	0.0021	< 0.002	0.010
Orange juice	8	4	0.0094	< 0.001	0.046
Oysters	8	0	0.9695	0.783	1.380
Pasta, dried	8	6	0.0149	< 0.002	0.086
Peaches, canned	8	0	0.0131	0.004	0.020
Peanut butter	8	6	0.0513	< 0.010	0.370
Peanuts, whole	8	5	0.0106	< 0.010	0.030
Pear	8	7	0.0014	< 0.002	0.004
Peas	8	7	0.0013	< 0.002	0.003
Pineapple, canned	8	1	0.0150	< 0.002	0.028
Pizza	8	0	0.0309	0.017	0.060
Pork chop	8	0	0.0093	0.004	0.022
Potato crisps	8	3	0.0131	< 0.010	0.030
Potato, hot chips	8	2	0.0700	< 0.002	0.257

IODINE content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Potatoes, peeled	8	2	0.0028	< 0.002	0.005
Potatoes, with skin	8	0	0.0109	0.002	0.027
Prunes	8	0	0.0079	0.004	0.013
Pumpkin	8	5	0.0044	< 0.002	0.013
Raisins/sultanas	8	1	0.0167	< 0.002	0.027
Rice, white	8	3	0.0031	< 0.002	0.005
Salad dressing	8	3	0.0356	< 0.010	0.170
Sausages	8	0	0.0802	0.012	0.261
Silverbeet	8	2	0.0270	< 0.002	0.104
Snack bars	8	2	0.1025	< 0.010	0.490
Snacks, flavoured	8	0	0.0575	0.020	0.110
Soup, chicken	8	0	0.0210	0.006	0.078
Soy milk	8	0	1.3134	0.005	9.140*
Spaghetti in sauce, canned	8	0	0.0199	0.013	0.039
Strawberries	7	5	0.0021	< 0.002	0.007
Sugar	8	8	0.0050	< 0.010	< 0.010
Taro	8	3	0.0061	< 0.002	0.012
Tea	8	6	0.0006	< 0.001	0.001
Tomato	8	7	0.0011	< 0.002	0.002
Tomato sauce	8	0	0.0136	0.002	0.023
Tomatoes in juice	8	2	0.0055	< 0.002	0.012
Water	8	1	0.0023	< 0.001	0.005
Wheat biscuit cereals	8	8	0.0050	< 0.010	< 0.010
Wine, still red	8	0	0.0090	0.002	0.014
Wine, still white	8	1	0.0049	< 0.001	0.012
Yeast extract	6	0	0.0552	0.020	0.090
Yoghurt	8	0	0.0831	0.055	0.110

* NB includes anomalous iodine result in one product line of one brand of soymilk

Table A 9.2 : Iron content (mg/kg) of 2003/04 NZTDS foods

IRON content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	8	0	0.9	0.7	1.0
Apple-based juice	8	2	0.5	< 1.0	2.8
Apricot, canned	8	0	2.3	1.4	3.4
Avocado	8	0	5.1	3.6	7.2
Bacon	8	0	6.1	5.4	7.0
Banana	8	0	2.2	1.7	2.8
Beans	8	0	5.3	3.9	7.2
Beans, baked, canned	8	0	11.5	9.2	14.6
Beef, mince	8	0	24.0	17.7	29.3
Beef, rump	8	0	33.7	24.9	47.0
Beer	8	8	0.1	< 0.1	< 0.1
Beetroot, canned	8	0	3.3	2.0	4.8
Biscuit, chocolate	8	0	30.2	10.0	53.3
Biscuit, cracker	8	0	18.3	10.0	38.0
Biscuits, plain sweet	8	0	10.8	6.0	19.0
Bran flake cereal, mixed	8	0	71.4	36.0	140.0
Bread, mixed grain	8	0	15.9	12.7	26.2
Bread, wheatmeal	8	0	17.5	14.6	19.5
Bread, white	8	0	12.9	7.6	39.2
Broccoli/cauliflower	8	0	4.5	3.0	5.9
Butter	8	8	0.5	< 1.0	< 1.0
Cabbage	8	0	2.7	1.7	4.3
Caffeinated beverage	8	8	0.1	< 0.1	< 0.1
Cake	8	0	9.3	6.8	11.2
Capsicum	8	0	2.1	1.4	2.9
Carbonated drink	8	8	0.1	< 0.1	< 0.1
Carrot	8	0	1.4	1.1	2.1
Celery	8	0	1.5	0.7	5.0
Cheese	8	3	1.1	< 1.0	2.0
Chicken	8	0	8.3	4.3	14.5
Chicken takeaway	8	0	6.8	5.7	10.1
Chinese dish	8	0	4.7	3.8	5.8
Chocolate beverage	8	0	3.7	0.5	7.4
Chocolate, plain milk	8	0	15.5	10.0	24.0
Coffee beans, ground	8	6	0.1	< 0.1	0.3
Coffee, instant	8	0	0.6	0.3	1.0
Confectionery	8	7	0.6	< 1.0	1.0
Corn, canned	8	0	2.8	1.9	3.4
Corned beef	8	0	19.2	15.6	21.0
Cornflakes	8	0	81.4	6.0	141.0
Courgette	8	0	3.1	2.0	5.6
Cream	8	0	0.4	0.2	0.5
Cucumber	8	0	1.0	0.6	1.4
Dairy dessert	8	2	1.3	< 0.2	3.2
Egg	8	0	9.3	6.5	12.2
Fish fingers	8	0	3.9	2.5	5.4

IRON content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Fish, battered	8	0	2.8	2.1	3.9
Fish, canned	8	0	9.6	7.1	14.7
Fish, fresh	8	0	2.3	1.4	3.3
Fruit drink	8	8	0.1	< 0.1	< 0.1
Grapes	8	0	3.4	2.4	4.9
Ham	8	0	7.7	6.8	9.0
Hamburger, plain	8	0	14.9	11.2	17.2
Honey	8	3	1.2	< 1.0	2.0
Ice-cream	8	3	0.3	< 0.2	0.5
Infant & Follow on formula	8	0	8.5	4.6	12.9
Infant weaning food, cereal based	8	1	47.0	< 0.2	129.0
Infant weaning food, custard/fruit dish	8	0	3.7	0.9	9.6
Infant weaning food, savoury	8	0	5.4	3.8	7.5
Jam	8	2	1.0	< 1.0	2.0
Kiwifruit	8	0	2.2	1.7	2.7
Kumara	8	0	3.9	3.3	4.8
Lamb/mutton	8	0	26.3	16.3	35.2
Lambs liver	8	0	147.1	62.5	435.0
Lettuce	8	0	2.7	1.1	4.1
Margarine	8	4	2.0	< 1.0	4.0
Meat pie	8	0	8.8	7.6	11.2
Melons	8	0	1.7	1.3	2.2
Milk, 0.5% fat	8	0	0.2	0.1	0.2
Milk, 3.25% fat	8	0	0.2	0.2	0.2
Milk, flavoured	8	0	0.9	0.5	2.1
Muesli	8	0	35.8	17.0	50.0
Muffin	8	0	11.3	7.6	19.5
Mushrooms	8	0	2.1	1.5	2.7
Mussels	8	0	88.3	32.8	154.0
Nectarine	8	0	1.4	0.8	1.9
Noodles, instant	8	0	6.0	3.0	17.5
Oats, rolled	8	0	8.5	6.5	9.8
Oil	8	4	2.0	< 1.0	4.0
Onion	8	0	1.8	1.6	2.2
Orange	8	0	1.0	0.8	1.2
Orange juice	8	0	0.7	0.3	1.4
Oysters	8	0	44.0	20.6	103.0
Pasta, dried	8	0	8.1	5.0	16.5
Peaches, canned	8	0	1.9	1.1	6.0
Peanut butter	8	0	16.4	13.0	23.0
Peanuts, whole	8	0	16.3	12.0	26.0
Pear	8	0	1.0	0.3	1.5
Peas	8	0	16.0	12.6	27.5
Pineapple, canned	8	0	1.2	0.6	2.0
Pizza	8	0	8.1	7.0	9.2

IRON content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Pork chop	8	0	7.9	5.2	9.4
Potato crisps	8	0	14.6	9.0	19.0
Potato, hot chips	8	0	7.3	5.6	9.2
Potatoes, peeled	8	0	3.1	2.1	3.8
Potatoes, with skin	8	0	6.0	3.7	8.7
Prunes	8	0	5.4	4.3	7.1
Pumpkin	8	0	2.3	1.9	3.5
Raisins/sultanas	8	0	15.1	11.8	21.5
Rice, white	8	0	0.7	0.4	1.1
Salad dressing	8	1	3.7	< 1.0	7.0
Sausages	8	0	14.5	12.3	16.3
Silverbeet	8	0	10.4	5.4	21.9
Snack bars	8	0	16.3	5.0	37.0
Snacks, flavoured	8	0	9.9	3.0	14.0
Soup, chicken	8	0	1.1	0.5	2.5
Soy milk	8	0	3.9	1.7	6.1
Spaghetti in sauce, canned	8	0	2.9	2.2	4.0
Strawberries	7	0	2.4	1.9	3.8
Sugar	8	8	0.5	< 1.0	< 1.0
Taro	8	0	6.5	2.3	8.2
Tea	8	3	0.2	< 0.1	0.4
Tomato	8	0	2.1	1.4	2.8
Tomato sauce	8	0	4.6	2.4	6.9
Tomatoes in juice	8	0	5.0	2.2	12.2
Water	8	8	0.01	< 0.02	< 0.02
Wheat biscuit cereals	8	0	67.8	29.0	173.0
Wine, still red	8	0	2.5	1.4	6.0
Wine, still white	8	0	1.2	0.5	3.1
Yeast extract	6	0	226.0	29.9	446.0
Yoghurt	8	1	0.6	< 0.2	2.0

Table A 9.3: Selenium content (mg/kg) of 2003/04 NZTDS foods

SELENIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	8	8	0.0020	< 0.004	< 0.004
Apple-based juice	8	8	0.0010	< 0.002	< 0.002
Apricot, canned	8	8	0.0020	< 0.004	< 0.004
Avocado	8	4	0.0053	< 0.004	0.012
Bacon	8	0	0.1381	0.118	0.180
Banana	8	8	0.0020	< 0.004	< 0.004
Beans	8	8	0.0020	< 0.004	< 0.004
Beans, baked, canned	8	0	0.0238	0.007	0.037
Beef, mince	8	0	0.0570	0.028	0.077
Beef, rump	8	0	0.0764	0.042	0.140
Beer	8	8	0.0010	< 0.002	< 0.002
Beetroot, canned	8	8	0.0020	< 0.004	< 0.004
Biscuit, chocolate	8	5	0.0178	< 0.020	0.043
Biscuit, cracker	8	1	0.0963	< 0.020	0.370
Biscuits, plain sweet	8	4	0.0413	< 0.020	0.160
Bran flake cereal, mixed	8	0	0.0875	0.050	0.130
Bread, mixed grain	8	1	0.0381	< 0.010	0.093
Bread, wheatmeal	8	4	0.0438	< 0.010	0.131
Bread, white	8	4	0.0354	< 0.010	0.102
Broccoli/cauliflower	8	4	0.0060	< 0.004	0.016
Butter	8	8	0.0100	< 0.020	< 0.020
Cabbage	8	6	0.0035	< 0.004	0.009
Caffeinated beverage	8	8	0.0010	< 0.002	< 0.002
Cake	8	0	0.0738	0.060	0.089
Capsicum	8	8	0.0020	< 0.004	< 0.004
Carbonated drink	8	8	0.0010	< 0.002	< 0.002
Carrot	8	7	0.0025	< 0.004	0.006
Celery	8	8	0.0020	< 0.004	< 0.004
Cheese	8	0	0.0550	0.050	0.070
Chicken	8	0	0.1990	0.101	0.317
Chicken takeaway	8	0	0.1091	0.055	0.135
Chinese dish	8	0	0.0423	0.026	0.061
Chocolate beverage	8	6	0.0015	< 0.002	0.003
Chocolate, plain milk	8	7	0.0113	< 0.020	0.020
Coffee beans, ground	8	8	0.0015	< 0.002	< 0.004
Coffee, instant	8	8	0.0010	< 0.002	< 0.002
Confectionery	8	8	0.0100	< 0.020	< 0.020
Corn, canned	8	4	0.0069	< 0.004	0.024
Corned beef	8	0	0.0446	0.033	0.052
Cornflakes	8	6	0.0188	< 0.020	0.060
Courgette	8	6	0.0031	< 0.004	0.008
Cream	8	0	0.0055	0.004	0.007
Cucumber	8	8	0.0020	< 0.004	< 0.004
Dairy dessert	8	2	0.0060	< 0.004	0.009
Egg	8	0	0.2685	0.242	0.309
Fish fingers	8	0	0.2545	0.189	0.397
Fish, battered	8	0	0.3014	0.188	0.420
Fish, canned	8	0	0.5055	0.311	0.772

SELENIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Fish, fresh	8	0	0.4920	0.370	0.585
Fruit drink	8	8	0.0010	< 0.002	< 0.002
Grapes	8	8	0.0020	< 0.004	< 0.004
Ham	8	0	0.1416	0.109	0.170
Hamburger, plain	8	0	0.0935	0.037	0.197
Honey	8	8	0.0100	< 0.020	< 0.020
Ice-cream	8	3	0.0069	< 0.004	0.015
Infant & Follow on formula	8	2	0.0108	< 0.002	0.027
Infant weaning food, cereal based	8	3	0.0075	< 0.004	0.020
Infant weaning food, custard/fruit dish	8	2	0.0101	< 0.004	0.024
Infant weaning food, savoury	8	1	0.0098	< 0.004	0.019
Jam	8	8	0.0100	< 0.020	< 0.020
Kiwifruit	8	5	0.0048	< 0.004	0.013
Kumara	8	8	0.0020	< 0.004	< 0.004
Lamb/mutton	8	0	0.0533	0.038	0.081
Lambs liver	8	0	0.1975	0.094	0.263
Lettuce	8	7	0.0029	< 0.004	0.010
Margarine	NA	NA	0.0059	0.006	0.006
Meat pie	8	0	0.0286	0.010	0.056
Melons	8	8	0.0020	< 0.004	< 0.004
Milk, 0.5% fat	8	0	0.0081	0.005	0.013
Milk, 3.25% fat	8	0	0.0066	0.003	0.010
Milk, flavoured	8	1	0.0058	< 0.002	0.009
Muesli	8	2	0.0550	< 0.020	0.130
Muffin	8	0	0.0483	0.034	0.072
Mushrooms	8	0	0.2161	0.132	0.336
Mussels	8	0	0.5650	0.449	0.639
Nectarine	8	8	0.0020	< 0.004	< 0.004
Noodles, instant	8	0	0.0291	0.005	0.055
Oats, rolled	8	2	0.0141	< 0.004	0.033
Oil	NA	NA	0.0010	0.001	0.001
Onion	8	5	0.0064	< 0.004	0.021
Orange	8	8	0.0020	< 0.004	< 0.004
Orange juice	8	8	0.0010	< 0.002	< 0.002
Oysters	8	0	0.4115	0.302	0.519
Pasta, dried	8	0	0.0531	0.015	0.179
Peaches, canned	8	8	0.0020	< 0.004	< 0.004
Peanut butter	8	0	0.1288	0.040	0.400
Peanuts, whole	8	0	0.0625	0.030	0.140
Pear	8	8	0.0020	< 0.004	< 0.004
Peas	8	8	0.0020	< 0.004	< 0.004
Pineapple, canned	8	8	0.0020	< 0.004	< 0.004
Pizza	8	0	0.0653	0.047	0.092
Pork chop	8	0	0.1373	0.098	0.183
Potato crisps	8	7	0.0113	< 0.020	0.020
Potato, hot chips	8	7	0.0023	< 0.004	0.004
Potatoes, peeled	8	5	0.0048	< 0.004	0.017

SELENIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Potatoes, with skin	8	4	0.0066	< 0.004	0.020
Prunes	8	7	0.0028	< 0.004	0.008
Pumpkin	8	7	0.0024	< 0.004	0.005
Raisins/sultanas	8	8	0.0020	< 0.004	< 0.004
Rice, white	8	3	0.0093	< 0.004	0.021
Salad dressing	NA	NA	0.0010	0.001	0.001
Sausages	8	0	0.0459	0.036	0.057
Silverbeet	8	4	0.0056	< 0.004	0.015
Snack bars	8	3	0.0275	< 0.020	0.050
Snacks, flavoured	8	3	0.0300	< 0.020	0.060
Soup, chicken	8	4	0.0058	< 0.004	0.019
Soy milk	8	0	0.0154	0.003	0.037
Spaghetti in sauce, canned	8	2	0.0095	< 0.004	0.032
Strawberries	7	7	0.0020	< 0.004	< 0.004
Sugar	8	8	0.0100	< 0.020	< 0.020
Taro	8	8	0.0020	< 0.004	< 0.004
Tea	8	8	0.0010	< 0.002	< 0.002
Tomato	8	8	0.0020	< 0.004	< 0.004
Tomato sauce	8	6	0.0033	< 0.004	0.007
Tomatoes in juice	8	7	0.0031	< 0.004	0.011
Water	8	8	0.0005	< 0.001	< 0.001
Wheat biscuit cereals	8	6	0.0313	< 0.020	0.100
Wine, still red	8	8	0.0010	< 0.002	< 0.002
Wine, still white	8	8	0.0010	< 0.002	< 0.002
Yeast extract	6	3	0.0172	< 0.004	0.030
Yoghurt	8	2	0.0059	< 0.004	0.009

NA = not analysed. Such foods have been assignned a mean value based on previous NZTDS or other New Zealand data (Vannoort et al, 2000)

Table A 9.4: Sodium content (mg/kg) of 2003/04 NZTDS foods

SODIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Apple	8	2	12	< 10	27
Apple-based juice	8	1	31	< 5	77
Apricot, canned	8	2	22	< 10	84
Avocado	8	0	86	52	157
Bacon	8	0	15250	12600	18900
Banana	8	8	5	< 10	< 10
Beans	8	8	5	< 10	< 10
Beans, baked, canned	8	0	4284	3190	5150
Beef, mince	8	0	811	559	1240
Beef, rump	8	0	671	561	776
Beer	8	0	18	13	29
Beetroot, canned	8	0	1567	349	3430
Biscuit, chocolate	8	0	1624	610	2795
Biscuit, cracker	8	0	4640	2410	7680
Biscuits, plain sweet	8	0	3620	2730	6870
Bran flake cereal, mixed	8	1	3147	< 50	7150
Bread, mixed grain	8	0	4469	3900	5210
Bread, wheatmeal	8	0	5006	4520	5910
Bread, white	8	0	5063	4710	5470
Broccoli/cauliflower	8	0	54	39	77
Butter	8	0	5586	5370	5960
Cabbage	8	0	82	35	145
Caffeinated beverage	8	0	605	176	956
Cake	8	0	3680	3270	3870
Capsicum	8	4	9	< 10	13
Carbonated drink	8	0	44	29	56
Carrot	8	0	364	213	554
Celery	8	0	455	175	843
Cheese	8	0	6304	5840	6940
Chicken	8	0	3521	850	7320
Chicken takeaway	8	0	7309	6380	9790
Chinese dish	8	0	4316	3590	5430
Chocolate beverage	8	2	57	< 5	106
Chocolate, plain milk	8	0	706	556	825
Coffee beans, ground	8	8	4	< 5	< 10
Coffee, instant	8	5	4	< 5	7
Confectionery	8	3	205	< 50	580
Corn, canned	8	0	1330	953	2470
Corned beef	8	0	8704	7290	11300
Cornflakes	8	0	7104	4460	9600
Courgette	8	8	5	< 10	< 10
Cream	8	0	249	224	268
Cucumber	8	2	20	< 10	32
Dairy dessert	8	0	569	493	723
Egg	8	0	1431	1340	1530
Fish fingers	8	0	3783	2880	5670
Fish, battered	8	0	2009	1520	2470

SODIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Fish, canned	8	0	2902	477	6130
Fish, fresh	8	0	738	542	931
Fruit drink	8	0	172	70	335
Grapes	8	2	26	< 10	69
Ham	8	0	13275	12100	15000
Hamburger, plain	8	0	4745	3760	6870
Honey	8	7	29	< 50	60
Ice-cream	8	0	459	373	647
Infant & Follow on formula	8	0	219	98	337
Infant weaning food, cereal based	8	1	130	< 10	285
Infant weaning food, custard/fruit dish	8	0	154	13	350
Infant weaning food, savoury	8	0	270	113	382
Jam	8	3	160	< 50	381
Kiwifruit	8	3	12	< 10	22
Kumara	8	0	152	78	218
Lamb/mutton	8	0	934	840	1090
Lambs liver	8	0	942	822	1070
Lettuce	8	0	30	21	55
Margarine	8	0	5409	3450	6550
Meat pie	8	0	4599	3840	5320
Melons	8	0	77	38	137
Milk, 0.5% fat	8	0	391	357	430
Milk, 3.25% fat	8	0	383	347	414
Milk, flavoured	8	0	410	334	611
Muesli	8	1	1147	< 50	4820
Muffin	8	0	4134	3530	4980
Mushrooms	8	0	57	46	82
Mussels	8	0	4643	2790	8700
Nectarine	8	8	5	< 10	< 10
Noodles, instant	8	0	3074	1820	4520
Oats, rolled	8	8	5	< 10	< 10
Oil	8	7	33	< 50	90
Onion	8	0	22	12	35
Orange	8	4	14	< 10	37
Orange juice	8	1	20	< 5	81
Oysters	8	0	4798	2350	6910
Pasta, dried	8	6	18	< 10	82
Peaches, canned	8	0	44	19	141
Peanut butter	8	0	4104	1590	6100
Peanuts, whole	8	0	3269	72	5830
Pear	8	6	6	< 10	11
Peas	8	5	9	< 10	22
Pineapple, canned	8	4	22	< 10	68
Pizza	8	0	5914	5250	7240
Pork chop	8	0	838	731	922
Potato crisps	8	0	3728	1990	5450
Potato, hot chips	8	0	2155	1300	2670
Potatoes, peeled	8	3	17	< 10	28
Potatoes, with skin	8	3	20	< 10	33
Prunes	8	3	19	< 10	42

SODIUM content (mg/kg) of 2003/04 NZTDS foods	Number of samples analysed	Number of samples < LOD	Mean (mg/kg) (ND=LOD/2)	Minimum (mg/kg)	Maximum (mg/kg)
Pumpkin	8	8	5	< 10	< 10
Raisins/sultanas	8	0	115	40	376
Rice, white	8	8	5	< 10	< 10
Salad dressing	8	0	6004	2190	8220
Sausages	8	0	7352	6130	9180
Silverbeet	8	0	716	518	1130
Snack bars	8	0	1682	640	3550
Snacks, flavoured	8	0	11569	5130	21300
Soup, chicken	8	0	3660	2920	4990
Soy milk	8	0	561	388	915
Spaghetti in sauce, canned	8	0	4140	3320	4790
Strawberries	7	5	34	< 10	109
Sugar	8	8	25	< 50	< 50
Taro	8	3	12	< 10	23
Tea	8	8	3	< 5	< 5
Tomato	8	0	36	16	90
Tomato sauce	8	0	7073	4760	8680
Tomatoes in juice	8	0	1170	49	2670
Water	8	0	9	5.5	12.9
Wheat biscuit cereals	8	1	2731	< 50	3920
Wine, still red	8	0	39	14	61
Wine, still white	8	0	41	12	103
Yeast extract	6	0	37267	32300	42000
Yoghurt	8	0	446	379	512

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