2003/04 New Zealand Total Diet Survey Summary

Agricultural Compound Residues, Selected Contaminants and Nutrients

NEW ZEALAND FOOD SAFETY AUTHORITY

by Dr Richard W. Vannoort and Dr Barbara M. Thomson

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.

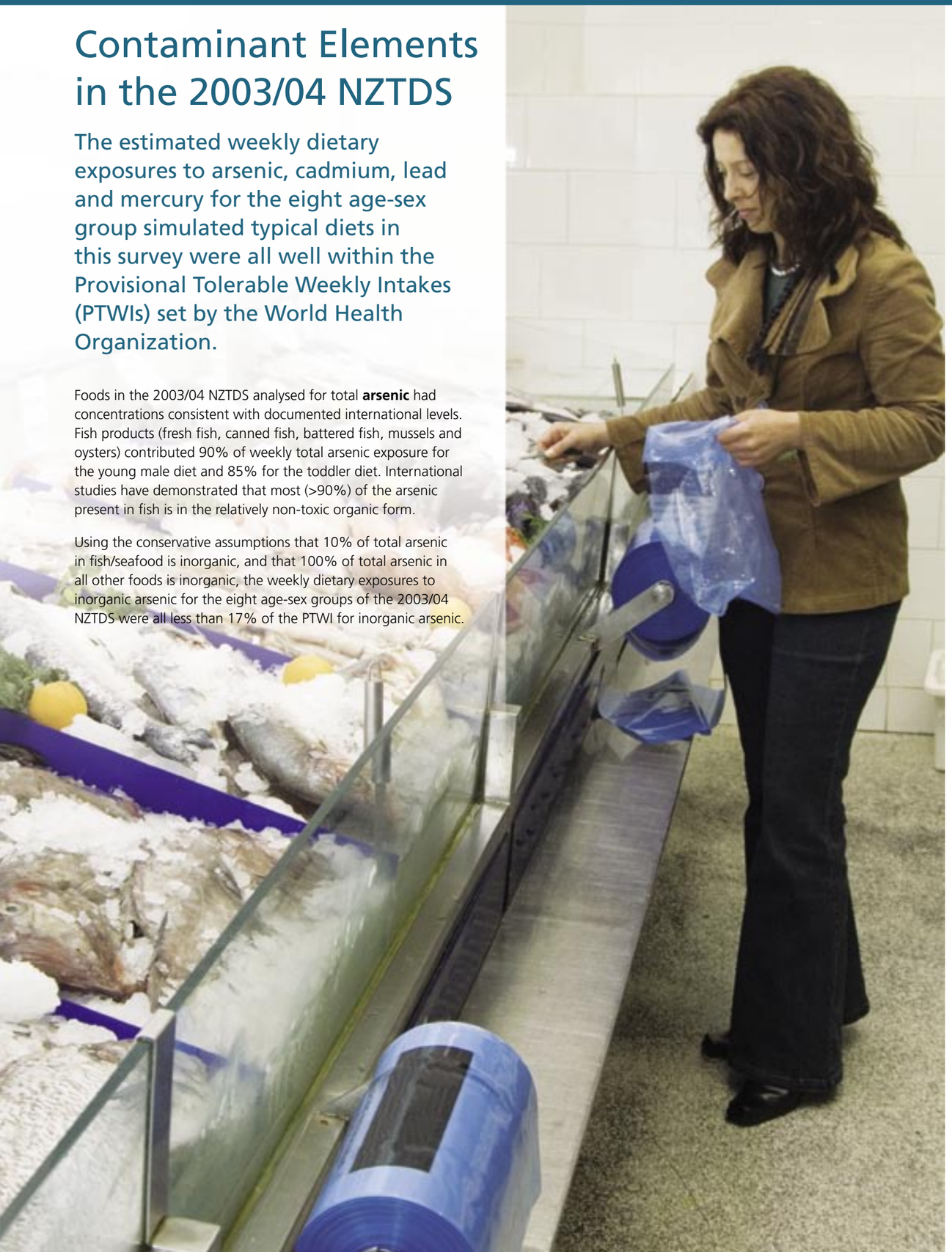
The highest estimated dietary exposures were for dithiocarbamate (DTC) fungicides. For adults, these ranged from 0.6 to 8%, and for children/infants from 1.2 to 19% of ADI. The upper bound range represents a worst case conservative estimate as it is based on the lowest available DTC ADI (ie the most 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.




Published in November 2005 by the

New Zealand Food Safety Authority

PO Box 2835, Wellington,

New Zealand

Disclaimer
Every effort has been made to ensure the information in this publication is correct.

NZFSA does not accept any responsibility or liability whatsoever for any error of fact, omission, interpretation or opinion that may be present, however it may have occurred.

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

ISBN 0-478-29802-1