The Canadian Total Diet Study

Presentation to the NCCEH/PHAC Environmental Health Workshop

Robin Churchill, Robert Dabeka and Don Forsyth

Bureau of Chemical Safety

February 25-26, 2013



Canada

Outline

1. Objective of the TDS
2. Design of the TDS
3. How TDS data is used
   - Radionuclides
   - Lead
   - Bisphenol A
4. Conclusions




Total Diet Study: Objective

- To provide a representative picture of exposure to substances that Canadians consume:
  - Foods are purchased at retail
  - Food samples are processed for consumption before analysis
  - Analysis is performed for specific chemicals
  - Dietary intakes are calculated using Canadian food intake data
- The Total Diet Study (TDS) has been ongoing since 1969, and provides an opportunity to:
  - Observe trends
  - Provide Canadian data that can be used in developing risk assessments and risk management strategies
  - Measure the effectiveness of RM strategies




Total Diet Study – A Mandated Activity

- The TDS is organized by the Food Research Division in the Bureau of Chemical Safety
  - data is used by partners within Health Canada
    - Nutrition Research
    - Evaluation Divisions
    - the laboratories of the Regions and Programs Branch
    - the Pest Management Regulatory Agency
    - HECSB
  - and outside of Health Canada
    - Canadian Food Inspection Agency
    - Codex (JECFA, CCFA, CCCF)
    - Other jurisdictions




Basic Study Design

- Approximately 1500 food samples from 4 different food retail outlets are purchased by CFIA inspectors in one Canadian city per year
- Collected foods are shipped to the University of Guelph, Kemptville Campus. Foods are:
  - prepared for consumption,
  - divided into composites using specific recipes developed by Health Canada.
- Food composites are homogenized, frozen and shipped to the testing laboratories.




Study Collection Sites




TDS - Design Specifics

- Annual collection from one city/year
  - Assists in managing work load with available laboratory capacity
  - Supports continuity of laboratory expertise
  - Facilitates trend analysis of chemical contaminant levels
- 159 food composites
  - Provides baseline levels of chemical contaminants in a wide range of food products which is a useful reference during suspected food contamination incidents
  - National screening of the food supply for accidental or deliberate contamination
- Four sources (brands) of each food per composite
  - E.g. 4- types pancake batter (incomplete) and 4- types waffles in pancake/ waffle composite
  - With such low dilution factors, contamination of only one food can be identified and traced to a specific source




Composites - Meat

Beef, steak	Lamb
Beef, roast	Luncheon meats, cold cuts
Beef, ground	Luncheon meats, canned
Pork, fresh	Organ meats
Pork, cured	Wieners and sausages
Veal, cutlets	




Composites- Ready to Eat, Fast Foods

Ready to Eat	
Frozen entrees	Popcorn - microwave
Fast Foods	
Pizza	Chicken burger
French fries	Hot dog
Hamburger	Chicken nuggets
Beef chow mein	Chicken fried rice
Breakfast sandwiches	Fast food sandwiches




Composites - Process

AA02/F/11/R - Milk, 2% - 8 x 500 ml –

Total amount of composite actually required: 1450 g

Routine: Milk 2%

Combine 300 ml of each of the samples and mix in a 2-L container

Dispense

- 100 g, 7plastic bottles
- 100 g, 6 glass jars
- 150 g, 1 plastic bottle (for radionuclides)
- Store remainder for Pancakes (FF14, Week 1)




Composites - Process

FF14/F/11/P - Pancakes (mix; 'incomplete') and Waffles (frozen) - 4 - (smallest package pancake mix) and 4 - (312 g package of frozen waffles)(to be combined in a ratio of 1:1)

Total amount of composite actually required: 1150 g

Routine: Pancakes

Prepare and cook pancakes following label directions.

Use butter (Composite AA12) in pan if required (rather than oil). Homogenize prepared pancakes with Kitchen Aid fine grater or Cuisinart.

Routine: Waffles

Toast as per package instructions.

Homogenize as described for pancakes.

Combine homogenates in Hobart in equal portions by weight (pancakes to waffles) and mix well

Dispense

- 100 g, 6 plastic bottles
- 100 g, 4 glass jars
- 150 g, 1 plastic bottle (for radionuclides)

Note: Use the following ingredients, if needed: Composite II01 (Cooking Fats and Salad Oils, Composite AA02 (Milk, 2%), Composite AA12 (Butter), Composite CC01 (Eggs)




TDS – Analytes of Interest

- Pesticides (registered and nonregistered)
- Polychlorinated biphenyls (PCBs)
- Dioxins and dibenzofurans
- PBDEs
- Trace elements (e.g. Pb, Cd, F, As, Hg)
- Perfluorinated compounds
- Ochratoxin-A
- BPA
- Radionuclides
- Phthalates

Analytes of interest are subject to review, with new ones (e.g. BPA) added as required

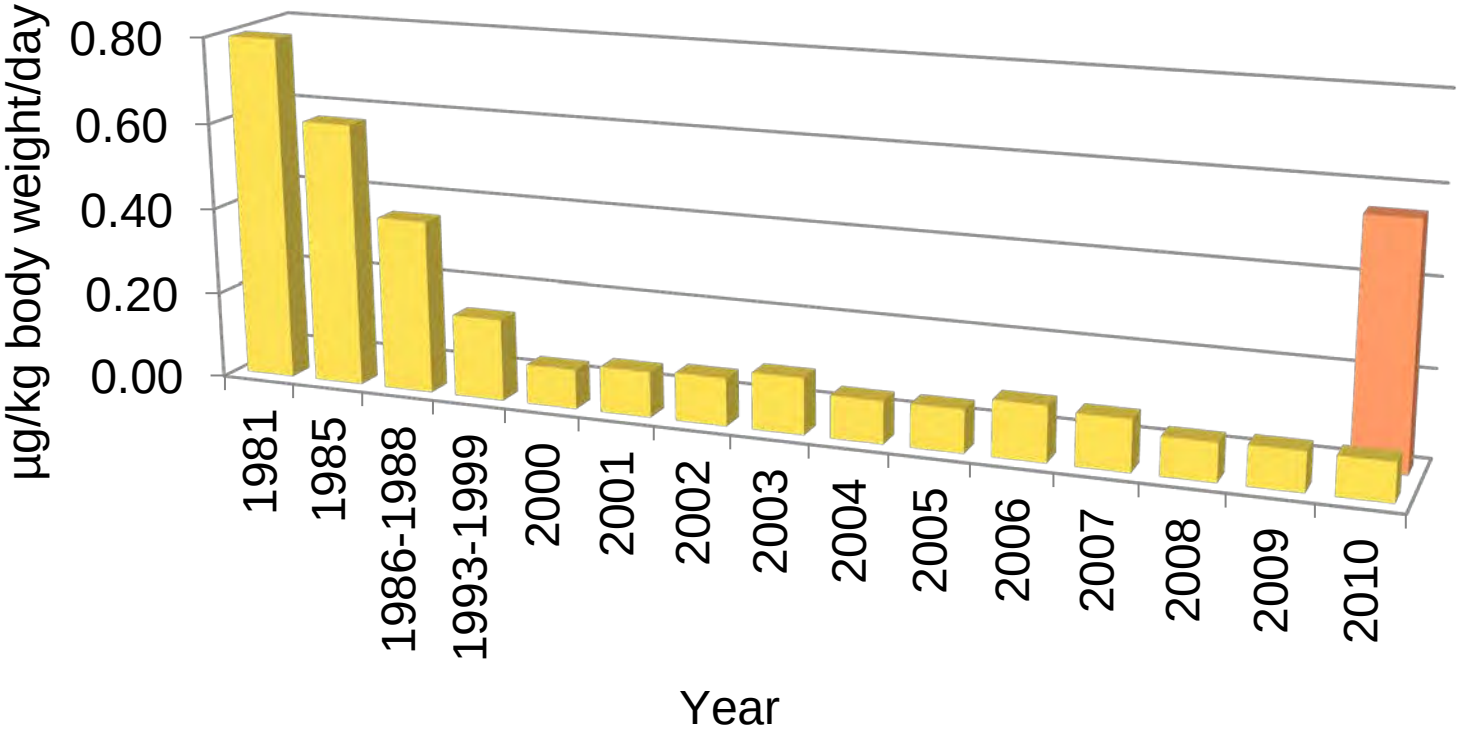



Fukushima Daiichi Nuclear Disaster

- **Total Diet radionuclide data was used as baseline for West Coast monitoring of retail foods, Japanese food imports**



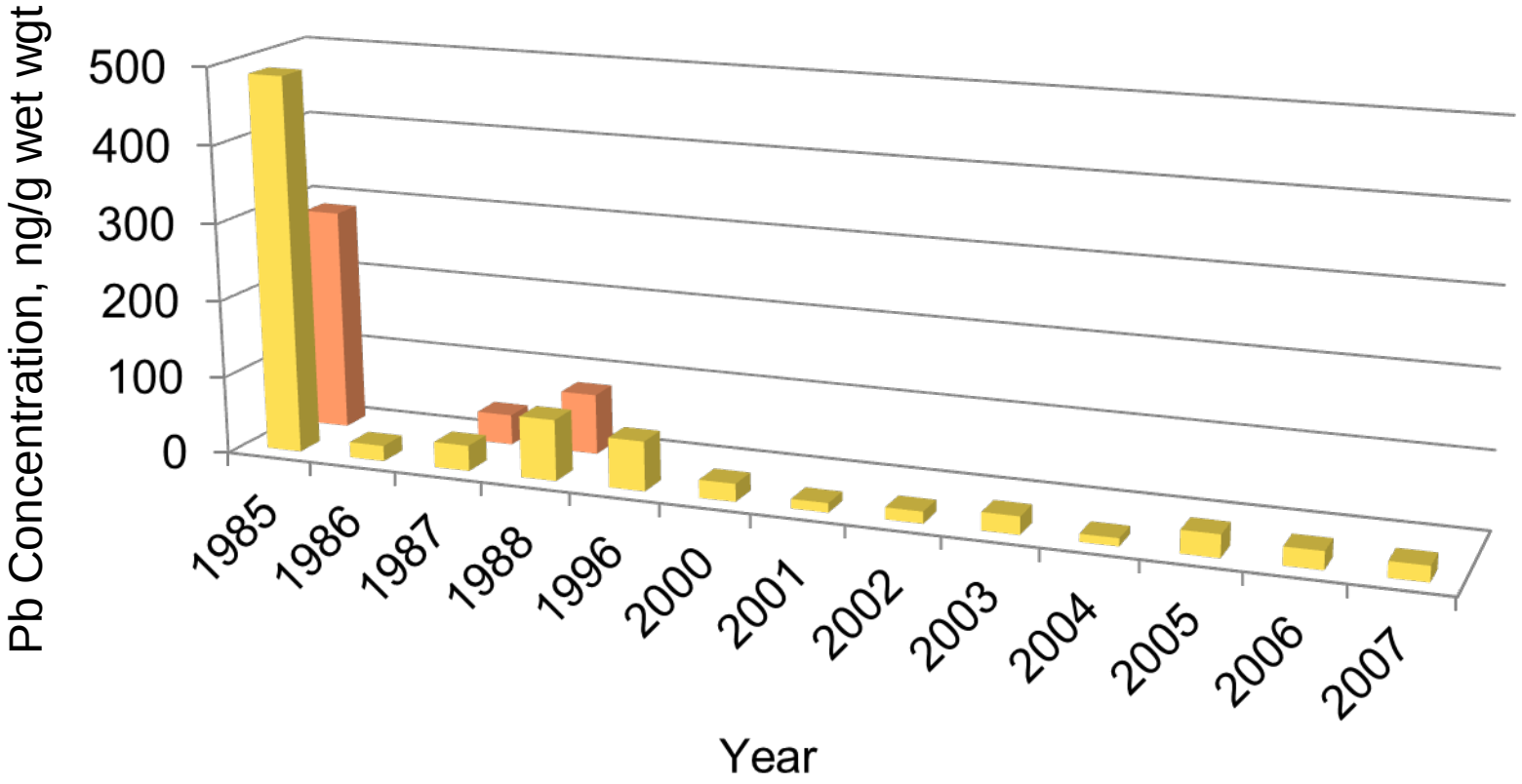

Lead Dietary Intakes – All Age Groups



***Note**: Orange bar represents one tea composite sample – reasons for this result have yet to be determined




Lead Concentration in Raisin Pie Composites



*** Note**: Orange bars represent when a second city was sampled in the same year




Effects of Lead – 2010 to present

- Effects are broader than, and occur below those determined 20 years ago
- No minimum ‘safe’ threshold for PbB is apparent
  - Sufficient evidence that PbB < 5 µg/dL are associated with adverse health effects
  - Chronic exposure to WHO pTWI would result in a BPb of 7 µg/dL
- BMR_{01} = 1.0 µg/dL (1 IQ point decrease)
  = 1.7 µg/dL (1% increase in average SBP)
- Source apportionment for food increases with age:
  - (13-23% infants, 27% toddlers, 38% children, > teens 74%)

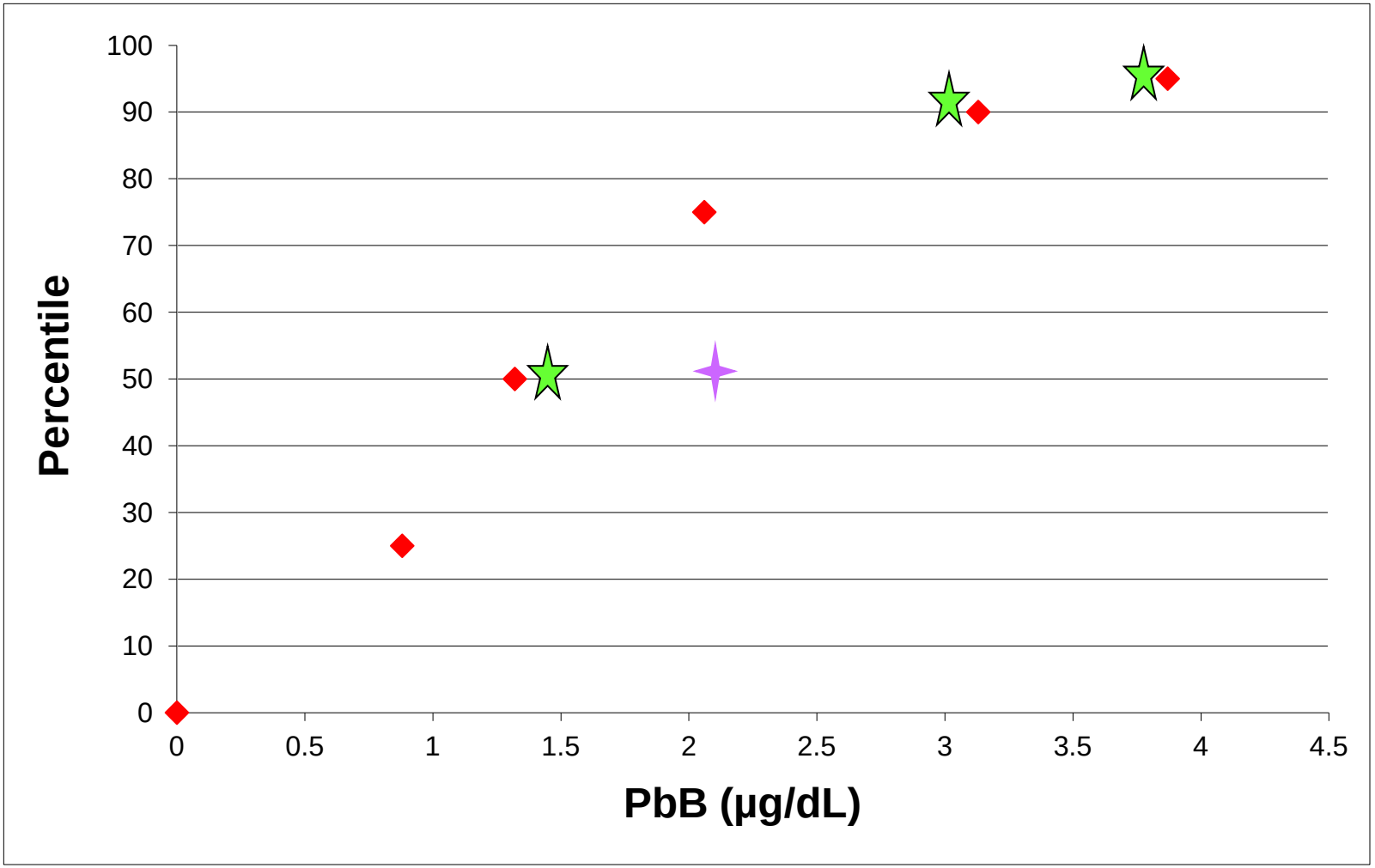



EFSA and JECFA Reviews of Lead – 2010

- The WHO PTWI was withdrawn as it was no longer considered appropriate:
  - No evidence for a threshold for critical lead-induced effects
  - Previous PTWI thought to be associated with a 3 IQ point decrease in children
  - Not possible to establish a new PTWI (dietary intakes 0.03-9.0 µg/kg bw/day)
- In withdrawing the PTWI, JECFA concluded, “in populations with prolonged dietary exposures to lead that are in the higher end of the ranges identified above, measures should be taken to identify major contributing sources, including foods, and to identify methods of reducing dietary exposure, if appropriate.”



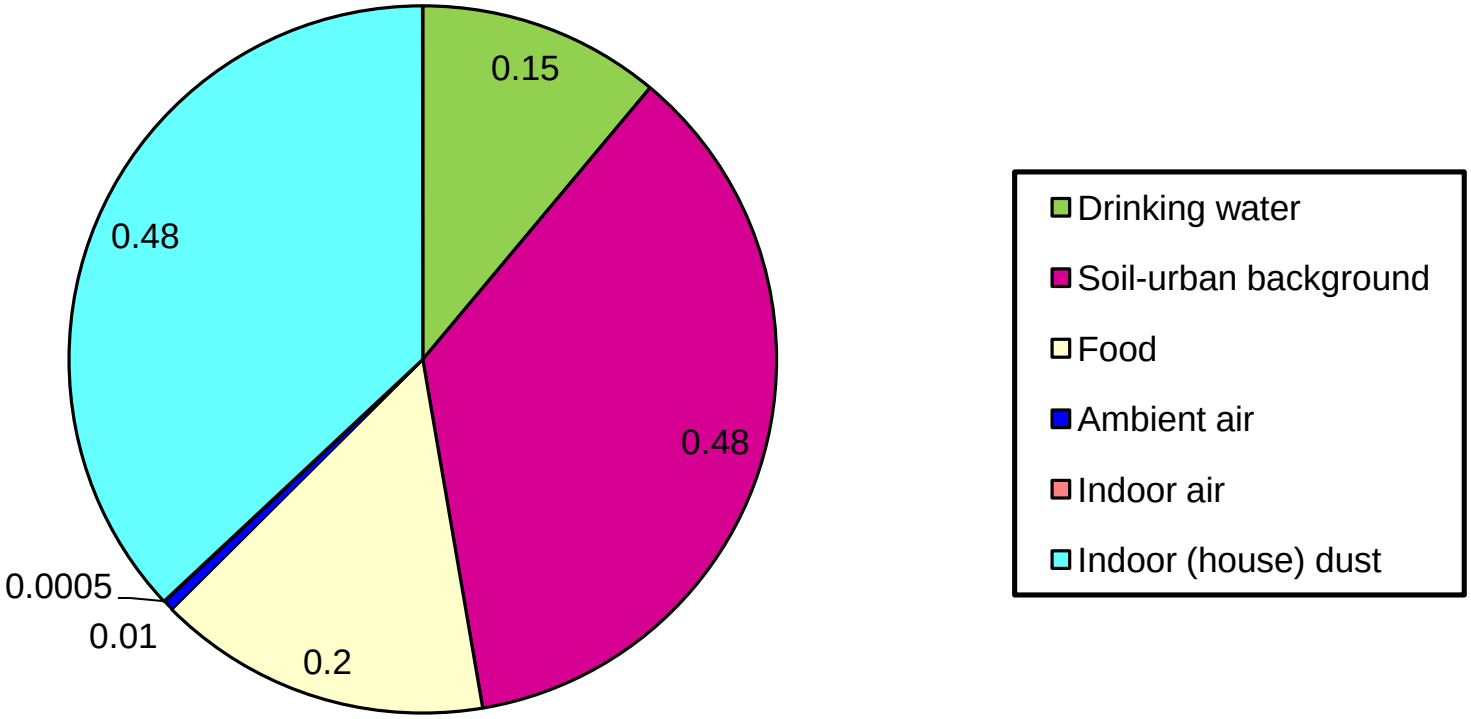

PbB Canada 2007-09






Lead - Current sources of exposure

Estimated Pb Intake (µg/kg/d)
Universal Chronic Sources
Total = 1.3 µg/kg/d






Dietary Exposure to Lead

Age Category	Median (µg/kg bw/day)	90th Percentile (µg/kg bw/day)	95th Percentile (µg/kg bw/day)
0-6 months	0.076	0.343	0.435
0.5-4 years	0.195	0.363	0.431
5-11 years	0.124	0.253	0.314
+12 years	0.069	0.148	0.180




Current Food Directorate Pb Management

- Published updated Approach for Managing Dietary Exposure to Lead
- Pb monitoring of food supply (CFIA/HC)
- Revisions to Pb tolerances consistent with Codex
- ALARA principle through identification/control of potential sources.




Current FD Approach to RA of Dietary Pb

- Compare results to known background levels
- Compare intake to latest TDS Results
- Is food commodity a staple
- Does it contribute disproportionately to the overall diet Pb
- What effect would consumption have on blood Pb




BPA – Introduction

BPA was assessed under the Chemicals Management Plan in 2008

Human Health hazard:

- Potential neurodevelopmental and behavioural effects

Human exposure:

- Highest exposure estimates were for newborns and infants
- Main exposure sources were from polycarbonate baby bottles (with addition of boiling water) and canned liquid infant formula

Conclusion:

- Applying a precautionary approach, it was concluded that BPA met the criteria in paragraph 64(a and c) of CEPA 1999




BPA – Risk Management Plan in 2008

- *Food and Drugs Act and Regulations*
  - Adopt the ALARA (as low as reasonably achievable) principle for food packaging intended for newborns and infants
  - Develop stringent migration targets for BPA in infant formula cans
  - Engage industry in the development and implementation of a code of practice to reduce levels of BPA in infant formula packaging to those consistent with the ALARA principle
  - Scrutinize pre-market submissions for infant formula to ensure the lowest levels of BPA in the food packaging achievable and facilitate the review of submissions for BPA alternatives in food packaging applications
  - Explore the option of establishing stringent migration targets for BPA in canned foods in general
  - Targeted surveillance of BPA in food (TDS)




M&S – Post 2008

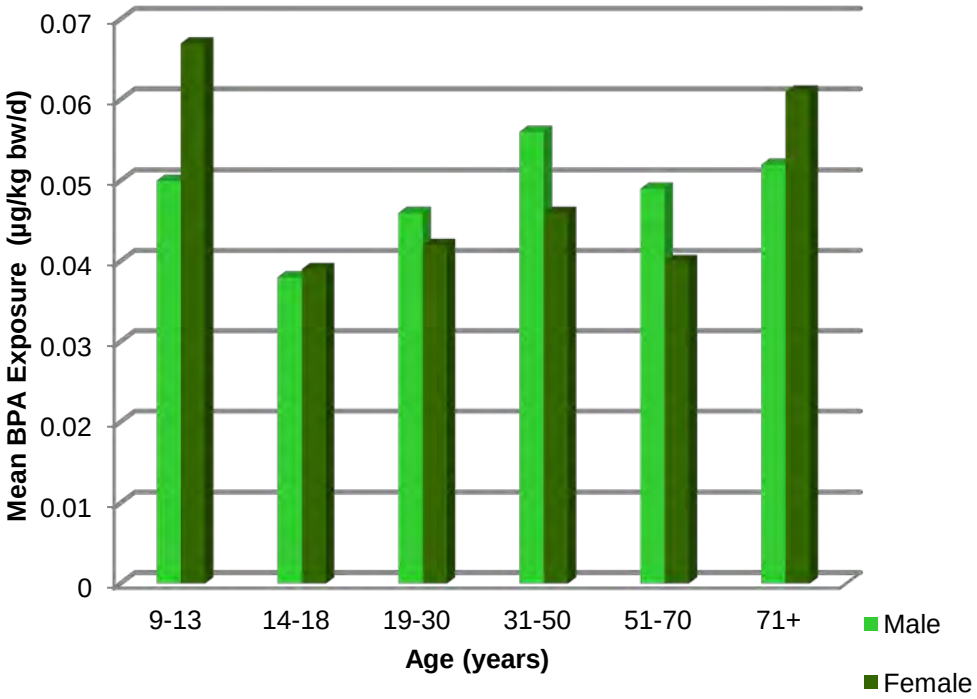
- Total Diet Study/ Targeted surveillance including:
  - Soft drinks, beer and bottled water products;
  - Canned food products
  - Canned powdered and liquid infant formulas
  - Baby foods prepackaged in glass jars with metal lids

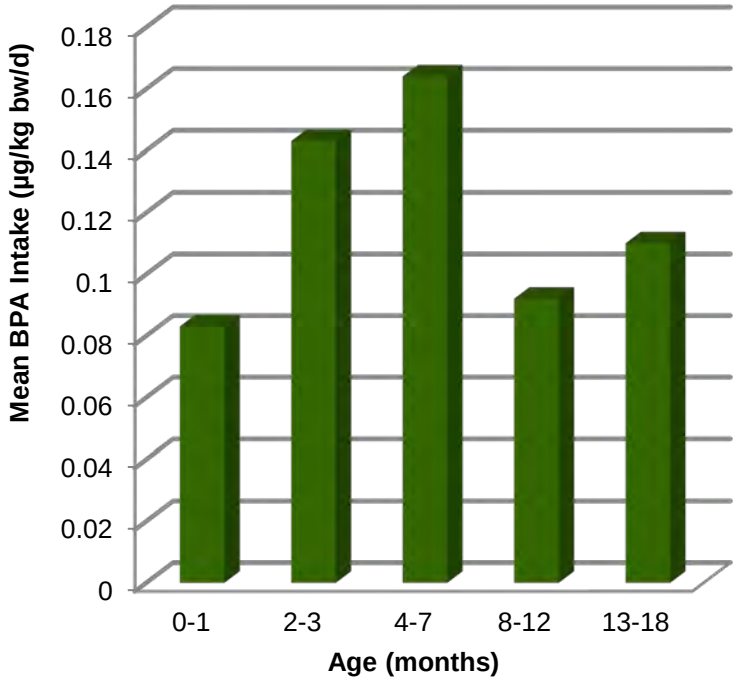
- A WHO/ FAO Expert Committee meeting was hosted by Canada in 2010 to assess the safety of BPA. TDS results were included in the data used to determine the outcome of the assessment




BPA – Updated Exposure Assessment

- Allowed Health Canada to refine its dietary exposure assessment based on a targeted sampling program and probabilistic statistical analysis:





- The updated intake assessment levels are ~3X lower than the exposures from the 2008 assessment for both the general population and infants




Risk Management of BPA - Current

- Based on the TDS data and updated probabilistic exposure estimate, the FD concluded that:
  - Dietary exposure to BPA does not represent a risk to the general population including infants
- Updated Risk Management Commitments for Food:
  - No longer identifies a need to set migration targets for BPA in infant formula or canned food in general.
  - No longer identifies a need to facilitate a Code of Practice
  - Will continue to treat food packaging submissions based on BPA-alternatives as a priority for assessment
  - Will continue to apply the ALARA principle when evaluating BPA-based packaging materials for infant formula.




TDS- Conclusions

- The Total Diet Study (TDS) is a primary source of information on the levels of various chemical contaminants and nutrients in the diet as consumed by Canadians.
- Provides an overall estimate of exposure to chemical contaminants through the diet.
- It can provide a general assurance that the food supply is safe from certain chemical hazards and assist in the development of priorities for possible risk management intervention or focussed surveillance.
- TDS results can also be used as an indicator of systemic environmental chemical contamination (baseline levels) by chemicals, allowing trend analysis of chemical contaminants in the food supply as a measurement of the effectiveness of measures taken to reduce exposure of the population to chemical hazards.





Thank-you !