

Dietary Exposure Pesticide Residues in Food

Thea Rawn, Ph.D.

Food Research Division, Bureau of Chemical Safety,
Health Products and Food Branch, Health Canada,
Ottawa, ON



Health Canada
Santé Canada

Canada 

Introduction

- Bureau of Chemical Safety, Food Directorate is actively involved in the measurement of chemicals in foods
- Focussed studies to answer specific questions
- Surveillance activities to determine levels in the food
 - Background levels
 - Ongoing monitoring
 - Raw foods and/or processed foods

Total Diet Study

Collaborative Effort

- Bureau of Chemical Safety
 - Coordinators: Dr. Robert Dabeka, Mr. John Moisey
 - Pesticide analysis: Ms Sue Quade, Dr. Wing-Fung Sun
- Health Products and Food Program, Health Canada
 - Manitoba Saskatchewan Region
 - Mr. Thor Halldorson
 - Ms Veronica Roscoe
- Canadian Food Inspection Agency (CFIA)
- University of Guelph
 - Department of Food Science, Kemptville College

Total Diet Study - History

- Established in 1969 to determine exposure to a limited number of chemicals in foods
 - Organochlorine insecticides
 - Expanded to include other man-made compounds (e.g., OP pesticides, PCBs, dioxins, etc.), trace elements, natural toxins, food processing induced chemicals (e.g., acrylamide), nutrients, etc.
- List of analytes change with time to ensure new and emerging issues are addressed
- Performed on an ongoing basis as surveillance of the Canadian situation

Background

- Annual collection of food samples from a Canadian city
 - Rotation of collection city; generally major urban centre in southern Canada
- Foods collected to represent an average Canadian diet
 - Evolves over time, changes to include different and/or additional foods as required
- Data can be used for trend analysis
- Intake estimates calculated based on concentrations in foods and the amount of food consumed

Study Collection Sites



Sample Collection

- Samples are collected by CFIA inspectors
 - Set time of the year: spring/fall
- Collection of each food from 4 different supermarkets, restaurants (fast foods), within the selected city
 - Foods generally purchased as raw, unprepared
 - Shopping based on 15 general categories
 - Domestic and imported foods collected

Categories of Food Collected

- Baby Food
- Beverages
 - Not belonging to other groups
- Cereals
- Dairy
- Fast food
- Fats & oils
- Fish
- Fruit
- Meats
- Miscellaneous (e.g., candy)
- Other (e.g., condiments)
- Packaged foods (e.g., frozen entrees)
- Poultry and related products
- Soups
- Vegetables

Sample Preparation

- Retail foods collected and shipped to Kemptville College
 - Processed as for consumption
 - Composite samples prepared
- Annual preparation of approximately 140 food composite samples following pre-set recipes
- Differs from compliance testing (CFIA)
 - Not prepared as consumed
- Food samples frozen and shipped for analysis

Pesticide Classes Currently Tested*

- Major insecticide classes include:
 - Organochlorine insecticides
 - Organophosphorus insecticides
 - *N*-methyl carbamates
- Representative herbicide/fungicides:
 - Triazines
 - Dinitroanilines
 - Dichloroanilides
 - Carbamate herbicides
 - Substituted ureas
 - Phthalimide fungicides

*70 pesticide compounds monitored

Limitations

- Not all diets are included in the 'average diet' (e.g., ethnic)
- Consumption pattern data needs updating (ongoing effort)
- Analysis conducted on composite samples from 4 from different sources, rather than individual samples
- Limited to one sample collection annually
 - Source of food and pesticide use is different throughout the year

Limitations continued

- Turn around time of analysis is slower than for compliance testing
 - Results do not lead to compliance action
- Not measuring new pesticides that are not amenable to our current analytical methods

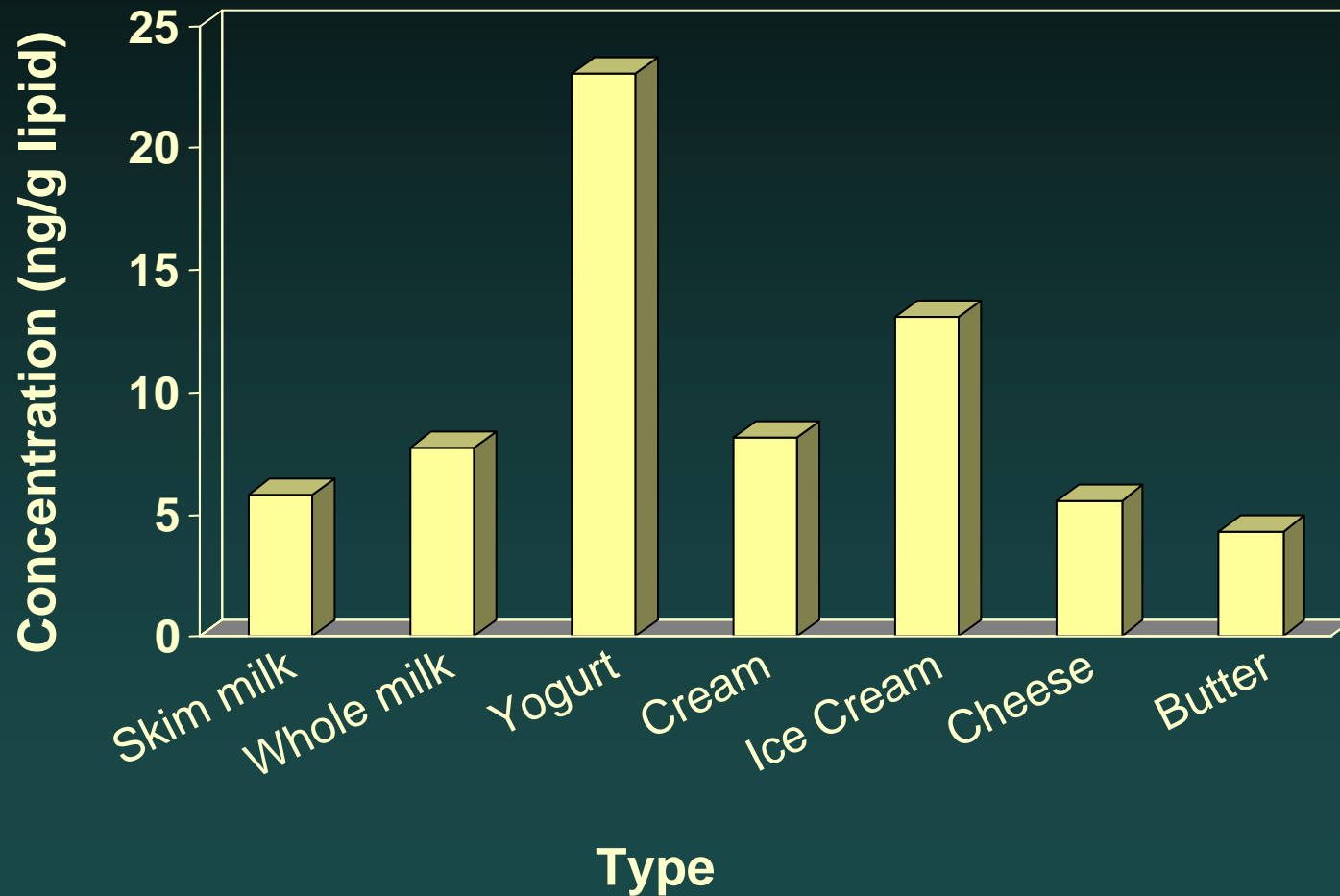
Results

- Pesticide concentrations generally low
 - Commodity to commodity differences
- Maximum residue limits (MRL) rarely exceeded
- Variable concentrations observed from year to year, multiple impacts
 - Weather
 - Infestations
 - Source of food
 - Different climates, different regulations and time of year all impact pesticide use

Observations

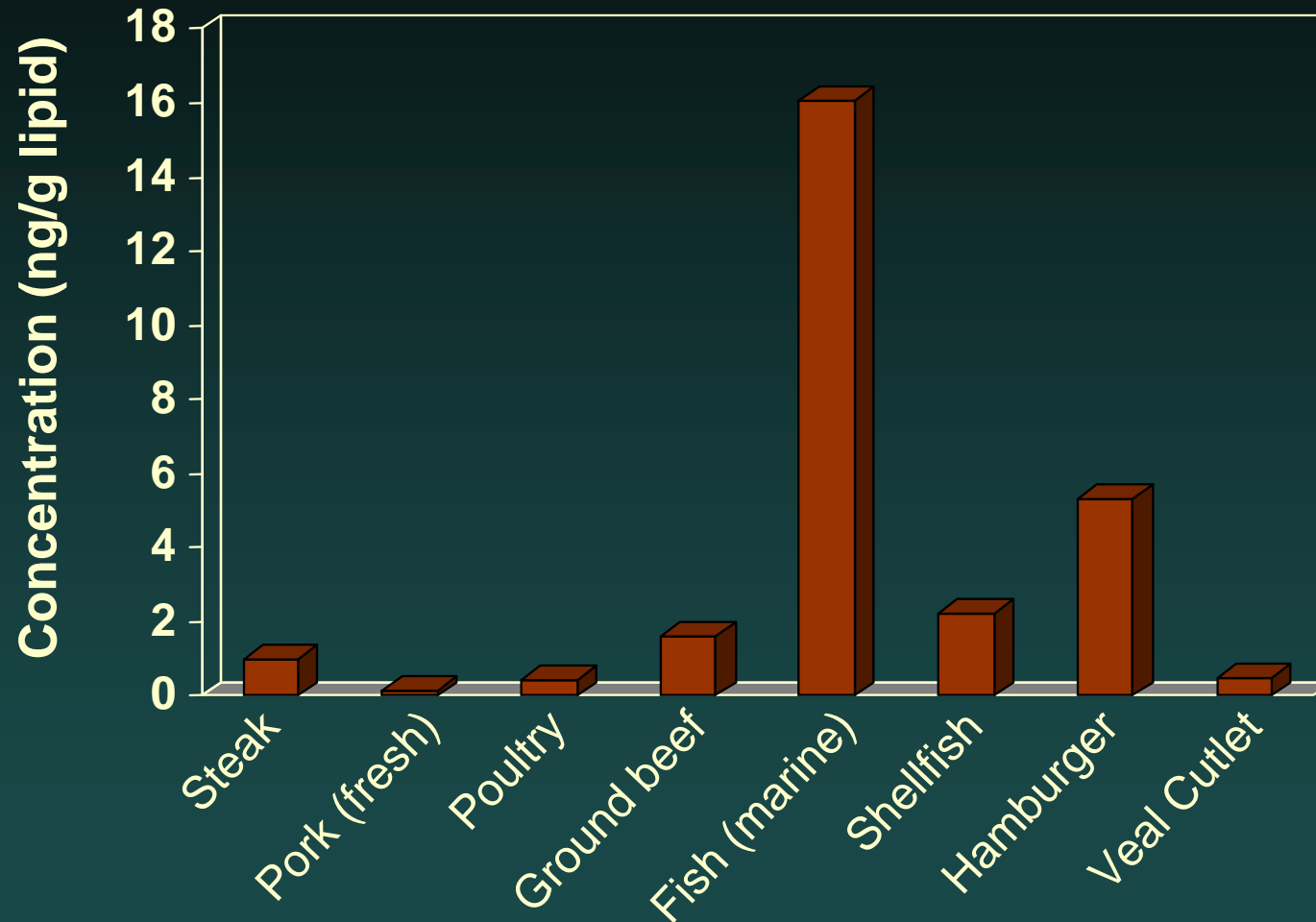
- Some composite samples contain foods of both animal and plant origin (e.g., pizza)
 - Focus for today's presentation generally is foods of plant origin
- 104 composite samples (2005 sampling year)
 - 9 samples had ≥ 30 pesticide residues detected
 - Maximum concentration observed in plum/prune sample (2,070 ng/g Iprodione, MRL = 2,000 ng/g)
 - 13 samples had < 10 detectable pesticide residues
- No sample free of pesticide residues

+DDT Levels in Dairy Products



MRL = 1,000 ng/g lipid

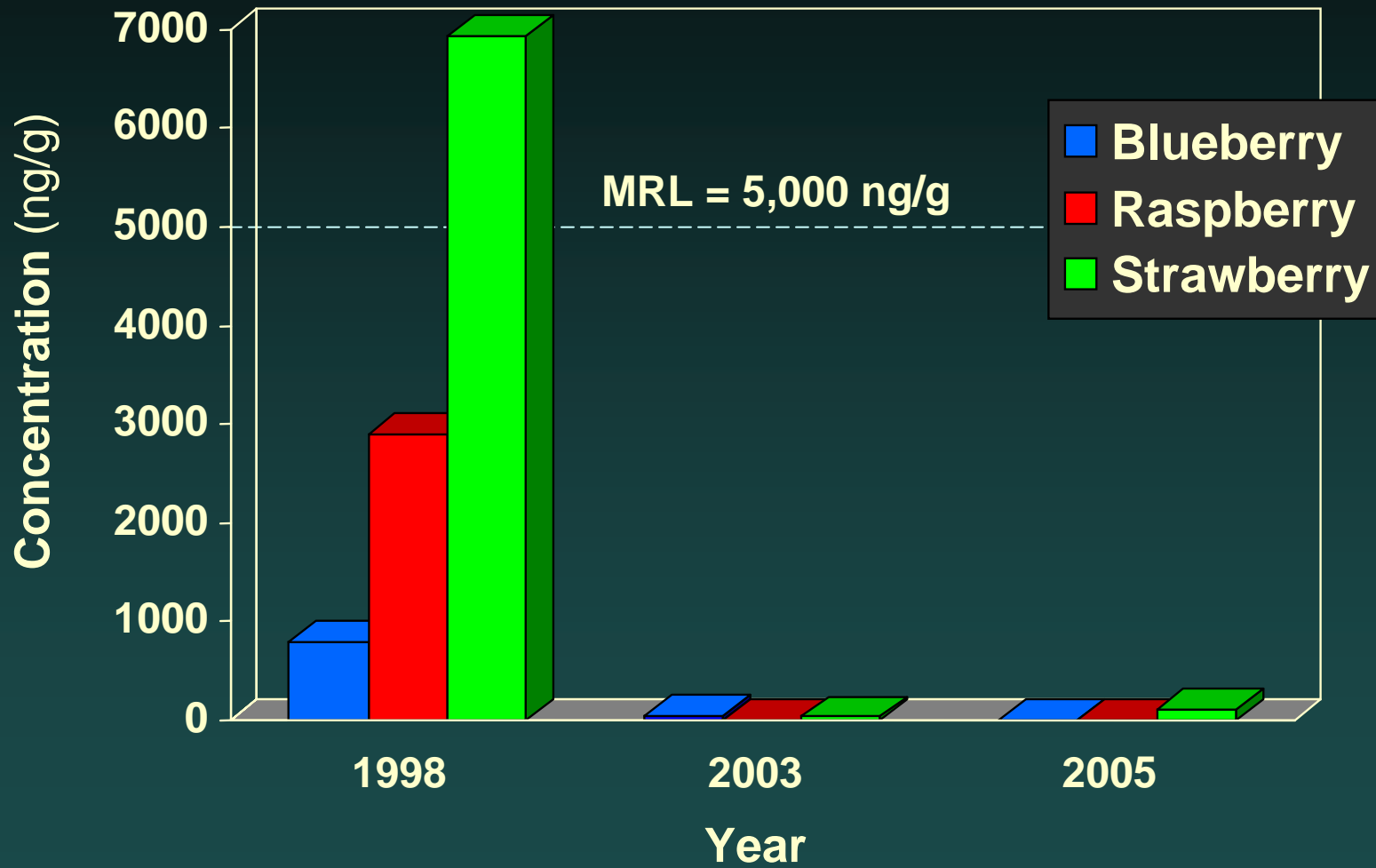
Dieldrin in Meat/Poultry/Fish



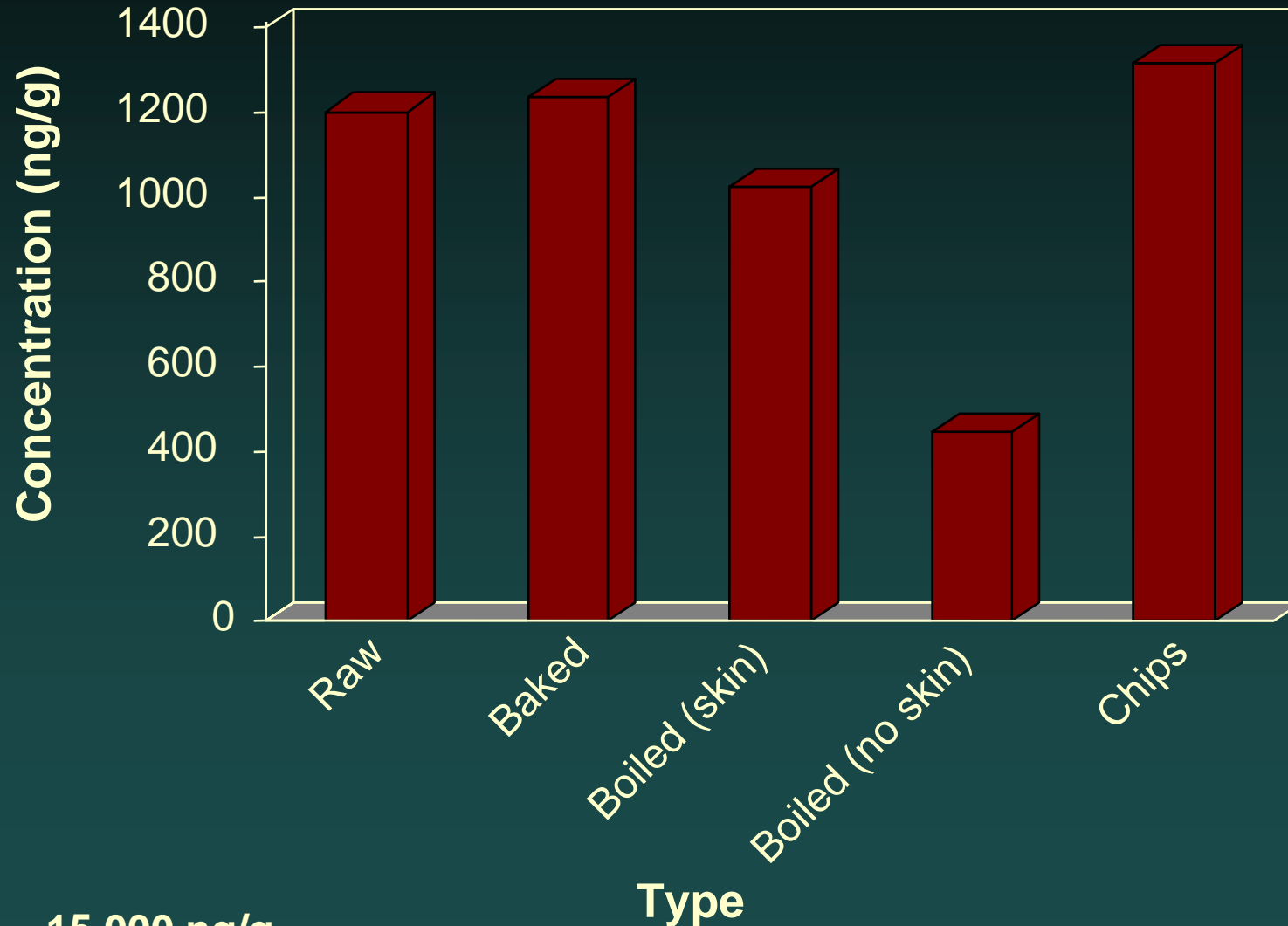
MRL = 100 ng/g lipid

Type

Captan Levels in Berries

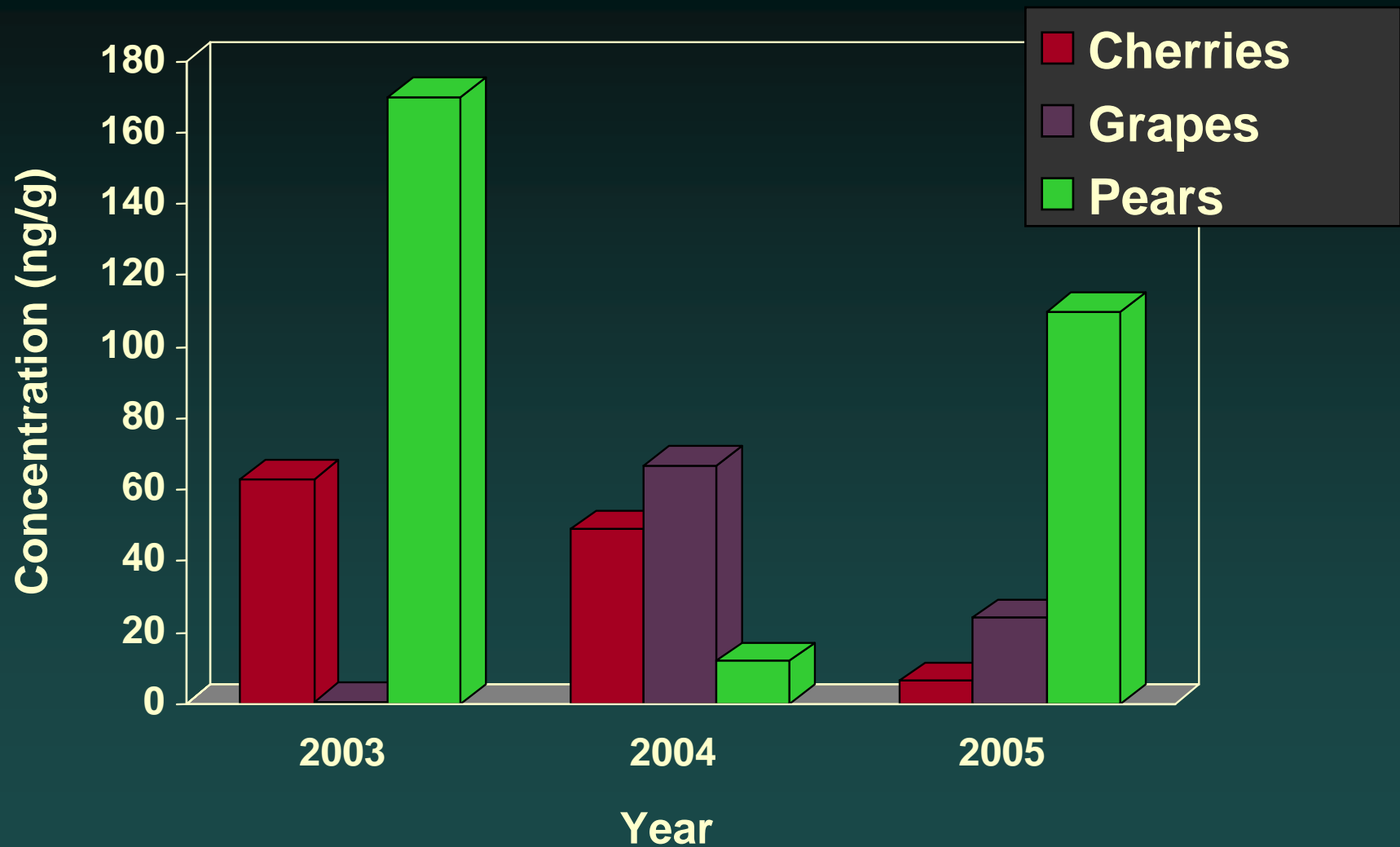


Chlorpropham in Potato Products (1998)



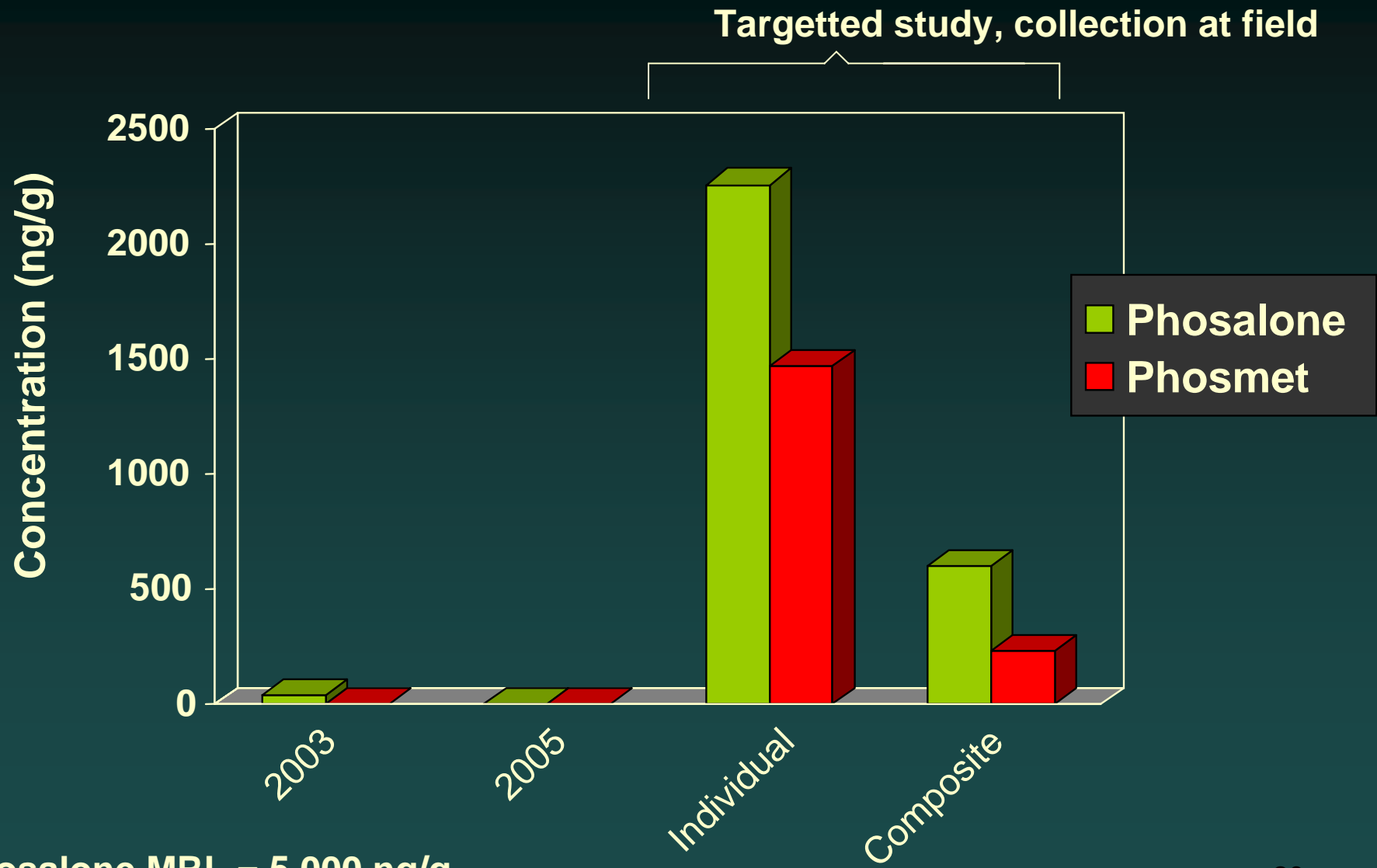
MRL = 15,000 ng/g

Carbaryl in Fruit



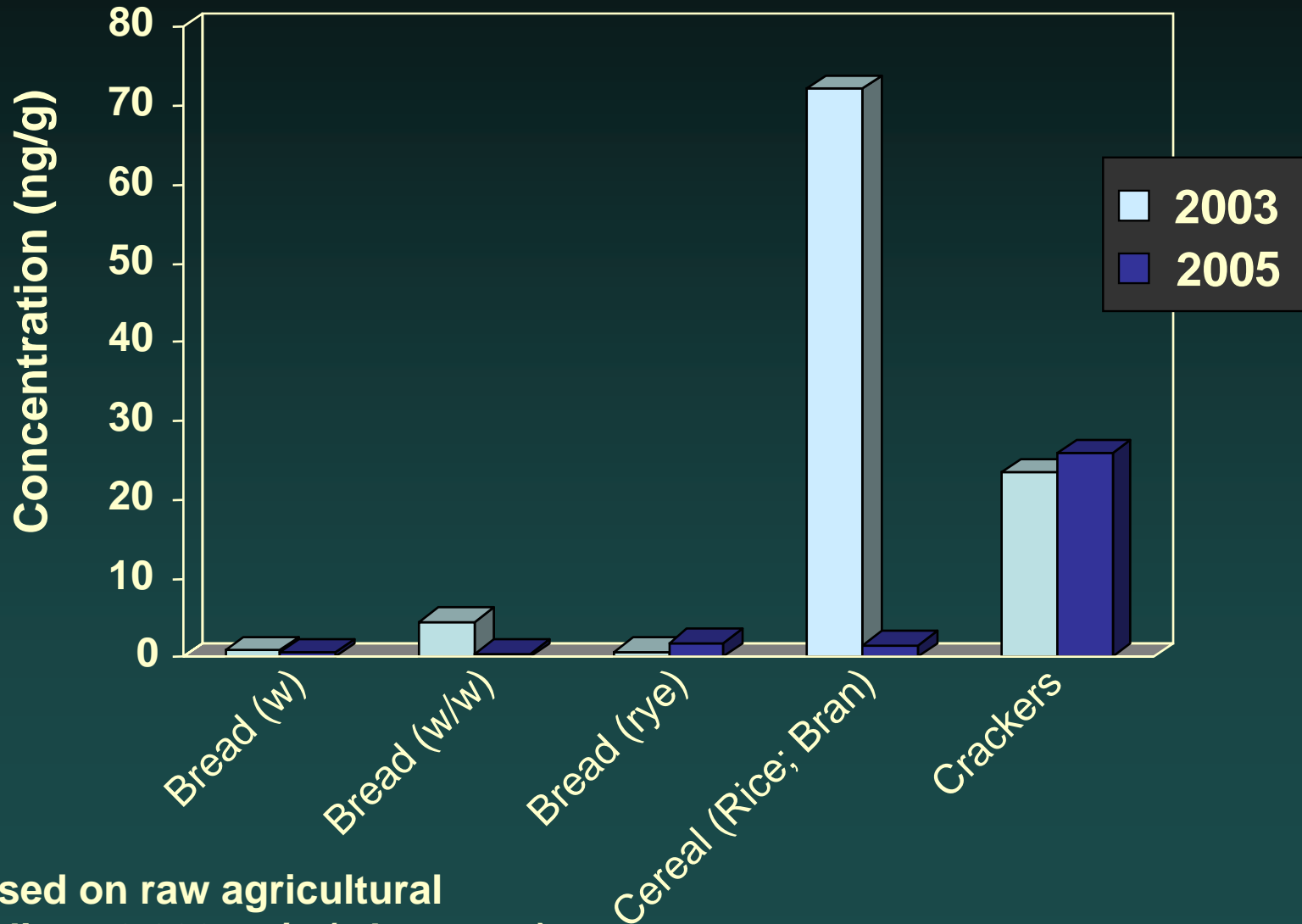
MRL = 10,000 ng/g cherries
MRL = 5,000 ng/g grapes, pears

Phosalone and Phosmet in Apples



Phosalone MRL = 5,000 ng/g
Phosmet MRL = 10,000 ng/g

Malathion in Grain Products



MRL based on raw agricultural commodity = 2,000 ng/g (wheat, rye)

Comparison Between Detected Levels and MRLs in Onions (ng/g)

Pesticide	Concentration	MRL
+Chlordanes	0.009	100
Chlorpropham	1.2	100
+DDT	0.003	500
Dacthal	0.002	1,000
Dieldrin	0.04	100
+Endosulfan	0.003	100
Hexachlorobenzene	0.001	100
Lindane	0.005	3,000

Comparison Between Detected Levels and MRLs in Blueberries (ng/g)

Pesticide	Concentration	MRL
Captan	9.9	5,000
+Chlordanes	0.004	100
Chlorothalonil	0.02	600
Chlorpropham	1.7	100
+DDT	0.008	100
Diazinon	0.06	100
+Endosulfan	0.06	100
Hexachlorobenzene	0.001	100
Lindane	0.003	100
Malathion	1.5	8,000
Phosmet	0.02	5,000
Simazine	0.04	100

Concentrations Observed in Total Diet Study (ng/g)

Compound	Commodity	MRL	Canada	US
Captan	Strawberries	5,000	11 – 6,900	0.8 – 2,900
Carbaryl	Pears	5,000	12 - 170	4.0 – 190
Chlorpropham	Potato chips	15,000	1.2 – 2,000	0.4 – 2,900
DDE	Cottage cheese	1,000	0.21 – 5.1	0.1 – 5.0
Dieldrin	Ground beef	100	0.06 – 0.2	0.1 – 1
Phosalone	Apples	5,000	0.2 – 43	3 – 50
Phosmet	Apples	10,000	0.01 – 4.3	2.0 – 120

Estimated Intakes ($\mu\text{g}/\text{kg}/\text{d}$)

Age Group → Compound	5 -12 M/F	12 – 19 M	12 – 19 F	40 – 64 M	40 – 64 F
Captan (¹ ADI = 100)	0.040	0.016	0.013	0.011	0.015
Chlorpropham (ADI = 30)	1.60	1.40	1.00	0.46	0.33
Iprodione (ADI = 60)	0.25	0.12	0.13	0.22	0.12
Malathion (ADI = 300)	0.015	0.008	0.008	0.005	0.004
Phosmet (ADI = 10)	0.015	0.005	0.006	0.005	0.005

¹Acceptable Daily Intake (World Health Organization 2003)

Benefits of Total Diet Study

- Provides concentration data for a variety of chemical classes in food as consumed
 - Data available for exposure assessment
 - Estimate of dietary exposure based on whole diet
 - Establish whether concentrations are out of general range
 - Allows for follow up studies as required

Summary

- Pesticides are observed in total diet study samples
 - Not all samples have all pesticides
 - Most compounds observed at low concentrations
- Higher concentrations are often observed in fruit and vegetables relative to other commodities
 - MRL are rarely exceeded
- Acceptable daily intakes are not exceeded