Total Diet Studies: Protecting the Public from Chemical Hazards in Food

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International Green Week
Berlin, Germany
21 January 2016
Der Mensch ist was er ißt.

Ludwig Feuerbach, 1863
Digging our graves with our teeth
Are Chemicals in Food Safe?
Paracelsus
Father of Toxicology

All substances are poisonous; there is none that is not a poison; the dose differentiates a poison from a remedy.

Paracelsus 1540
'Silent Spring' Is Now Noisy Summer

Pesticides Industry Up in Arms Over a New Book

By JOHN M. LEE

The $300,000,000 pesticides industry has been highly irritated by a quiet woman whose previous works on poison have been praised for the beauty and economy of the writing.

The author is Rachel Carson, also author of 'The Sea Around Us' and 'The Edge of the Sea.' The new book is billed as a sequel, though its author has written a massive new volume on the subject of pesticides.

Rachel Carson Stirs Conflict—Producers Are Crying 'Foul'

While the industry has praised Carson's work for its clarity and objectivity, it has been highly critical of her new book, which it claims is inaccurate and alarmist.

In Washington and New York, meetings have been called to discuss the effects of the book on the industry's sales. Critics argue that the book is nothing but a publicity stunt to boost sales of Carson's previous works.

Meanwhile, producers are sounding the alarm, concerned that the book will lead to a decrease in their sales. They are also warning that Carson's claims could lead to legal action against the industry.
Low-Level Chemicals in Food

- Cannot be detected by sight, taste or smell
- Cannot generally be destroyed or removed
- Illness appears slowly over months, years or even decades.
Health Affects Linked to Chemicals

- Cancer
- Kidney and liver disease
- Hormonal imbalance
- Immune system suppression
- Musculoskeletal diseases
- Birth defects
- Premature births
- Impeded nervous development
- Reproductive disorders
- Mental health problems
- Cardiovascular diseases
- Genitourinary diseases
- Old-age dementia
- Learning disabilities
- Obesity?
- Diabetes?
Chemicals in food may have destroyed civilizations
Hazard is not Risk!

- An agent with the potential to cause harm
- Likelihood and severity of an adverse event.
Risk Analysis Paradigm

Risk Assessment
- Science based

Risk Management
- Policy based

Risk Communication
- Exchange of views and information
Risk Assessment Process

- Hazard Identification
- Hazard Characterization
- Exposure Assessment
- Risk Characterization
Hazard Identification

The agent and the associated adverse health effect

- Lead - neurotoxicity and hypertension
- Dioxins – endocrine disruption
- Cadmium – kidney injury
Priority Chemicals

- Food additives
- Pesticide residues
- Heavy metals
- Industrial pollutants
- Naturally occurring toxicants
- Processing/packaging contaminants
- Essential nutrients
Hazard Characterization

- Acceptable Daily Intake
- Provisional Tolerable Intake
- Margin of Exposure
- Recommended Dietary Intake
- Maximum Daily Intake
Exposure Assessment

Dietary Exposure = $C \times F$

$C =$ Concentration of chemical in the food

$F =$ Amount of the food consumed
Multi-Food Exposures

Dietary Exposure = \( \Sigma C_i \times F_i \)

\[ = C_a \times F_a + C_b \times F_b + C_c \times F_c + C_d \times F_d + \ldots \]

\( C_i \) = Concentration of chemical in food i

\( F_i \) = Amount of food i consumed
Every country has its own dietary pattern and methods of food preparation
Individual Consumption Survey

- 24 hour recall on 2 non-consecutive days
- Supplemented by food frequency
- At least 5,000 respondents
- All cohorts by age and sex
Methylmercury in Fish

Amount of fish consumed = 100 g/week
Concentration of chemical = 2 mg/1000 g

Exposure = .2 mg/week

Expressed on body weight = .0040 mg/week/kg bw for 50 kg person

Compare with PTWI of .0016 mg/week/kg bw
Multi-Food Exposures

Dietary Exposure = \( \Sigma C_i \times F_i \)

\[ = C_a \times F_a + C_b \times F_b + C_c \times F_c + C_d \times F_d + \ldots \]

\( C_i = \text{Concentration of chemical in food } i \)

\( F_i = \text{Amount of food } i \text{ consumed} \)
Levels of Chemicals in Food

How to assess low levels of multiple chemicals in multiple food?

Total Diet Studies
Steps in a Total Diet Study

- Conduct survey on the amounts of food consumed by individuals in each cohort, including food preparation details
- Collect and prepare foods as typically consumed
- Measure chemical of interest in those prepared foods
- Estimate dietary exposure to a chemical
- Compares exposure estimates with the health-based guidance level
Advantages of Total Diet Studies

- Foods are analyzed "as consumed" providing the best estimate of actual dietary exposure
- Assesses mean and high percentile exposures for age/sex cohorts and other groups of interest
- A large number of chemicals can be evaluated in one study
- Most cost-effective method for obtaining dietary exposure information
Advantages of Total Diet Studies

- Provides a scientific basis for justifying and establishing maximum limits as required by international agreements.
- Provides a tool for assessing the effectiveness of intervention measures.
- Simple and easy to understand for managers and consumers.
- Periodic studies can provide baseline information on the levels and trends of chemicals in the food supply.
Countries with Total Diet Studies

Australia, Belgium, Cameroon, Canada, Chile, China, Czech Republic, Columbia, Croatia, Denmark, Egypt, Estonia, Finland, France, Fiji, Germany, Guatemala, India, Indonesia, Ireland, Italy, Japan, Republic of Korea, Kuwait, Latvia, Lebanon, Malaysia, the Netherlands, New Zealand, Norway, Panama, Papua New Guinea, Poland, Portugal, Slovak Republic, Spain (National, Basque Country and Catalonia), Sweden, Switzerland, Taiwan (China), Tunisia, Turkey, United Kingdom and United States of America
And soon, many others
Protecting Our Future
Improving Our Future
Thank You For Your Attention

Danke für Ihre Aufmerksamkeit