Food Consumption Data in Microbiological Risk Assessment

Barbara J. Petersen and Leila M. Barraj
Exponent®
Food and Chemicals Practice
(formerly Novigen Sciences, Inc.)
Acknowledgement:

S. Kathleen Egan,
US Food and Drug Administration
Risk Assessment Paradigm

• Hazard Identification
• Exposure Assessment
• Hazard Characterization
• Risk Characterization
Using Consumption Data in Microbiological Risk Assessments

**Iterative process:**
- Consumption data $\rightarrow$ exposure (intake) estimates
- Intake estimates $\rightarrow$ risk estimates (e.g., illnesses, deaths per year)
- Risk estimates compared to actual or reported events
- Refine risk assessment if necessary
Exposure Assessment

• Pathogen concentration in food at time of consumption
  – Presence on/in food
  – Pathogen distribution on/in food
  – Pathogen concentration

• Consumption of food
  – Frequency of consumption
  – Amount consumed
Consumption Data

- Frequency of consumption
  - Number of meals
  - Number of servings
  - Per year, per week, per day

- Amount consumed
  - Per meal, per serving, per day
  - Average amounts, unit size, distributions

- Depend on purpose of assessment and data available
Consumption Patterns Related to:

- Population demographics
  - Age, gender, ethnicity, socio-economic characteristics
- Season
- Region
Characterize Consumption Patterns of:

- **Sensitive subpopulations**
  - Young children, elderly, pregnant women, immunodeficient, ...

- **High risk consumer behavior, e.g.,**
  - Consumption of unpasteurized dairy products
  - Consumption of undercooked meat products
Difference in Consumption Databases

• **How information is collected**
  – Consumer surveys, sales statistics, production statistics, …

• **Food form**
  – Foods as consumed, as purchased, raw agricultural commodities, …
Food Production Statistics

- Raw or semi-processed agricultural commodities
- Amount of food available for total population
  - Annual quantity of food available per person
  - Daily per capita amount
- National statistics on food production and utilization
- FAO Food Balance Sheets
- International assessments
Consumption Surveys

- National level or specific subpopulations
- Information on:
  - Types and amounts of foods consumed over a short period of time
  - Frequency of consumption of a pre-specified list of foods
- Limited number of countries
- Level of detail, method, and survey instrument vary across surveys
Retail Food Purchases

- Specific foods
- Typically at household level
- Often used to supplement information from food consumption surveys
Amount of Food Consumed

• Per-capita or per-user
  – Total population or restricted to consumers of the food
  – Difference depends on frequency of consumption
  – Data source
Amount of Food Consumed

- Per year, per day, per eating occasion
  - Acute or chronic effects
  - Daily
    - Restricted to consumption days
    - All survey days
  - Data source
Amount of Food Consumed

• **Point estimate**
  – Serving unit
  – Typical (average) amount
  – High end consumption amount

• **Entire distribution**
Frequency of Consumption

• Proportion of population consuming the food
• How often an individual consumes the food
  – Number of days per year in which food is consumed
  – Number of eating occasions per year
    • Annual number of meals
    • Number of times a food is consumed per year
    • Number of times a given portion size is consumed per year
Frequency of Consumption

• Assessment can be refined using sales volume or market share data
  – e.g., pasteurized and unpasteurized milk or juice sales

– Assume
  • x% of all eating occasions are for unpasteurized food form
  • Uniform distribution across entire population
  • Similar consumption amounts
Using Food Production Statistics

• **Total population → individuals within a population**
  – Uniform distribution?
  – Regional differences?
  – Ethnic, age, gender differences?

• **Annual statistics → daily estimates**
  – Seasonal differences?
  – Day of the week differences?

• **Raw agricultural commodities → foods as consumed**
  – Processing method?
  – Cooking method?
Using Consumption Surveys

• Sample of population → total population
  – Representative?
  – Statistical weights

• Limited number of days → long-term estimates
  – “Typical” days?
  – Day to day variability?

• Food groups → individual foods
  – Equal frequencies and amounts?
Using Consumption Surveys

- Infrequently consumed foods
  - Per user estimates
  - Per day or eating occasion
- Foods consumed in mixed dishes
  - Recipes?
- Joint exposure for multiple foods or for individual foods
  - Total exposure?
  - Risk from individual foods?
Using Consumption Surveys

- Typically focus on nutrition aspect
  - May focus on different subpopulations than those of interest
  - May not collect enough detail on foods consumed
- Raw data versus summary statistics
Using Consumption Surveys

• Food source
  – Home / store / restaurant / fast food
  – place / cafeteria / vending machine …

• Where consumed

• When was food consumed?
  – Time of day
  – With meal / meal name

• Source of drinking water
  – Bottled / CWS / well …
Using Consumption Surveys

• Information on consumer behavior typically missing:
  – Food handling
  – Cooking method
  – Cooking temperature and duration
  – Potential for cross contamination

• For most microbial contaminants, one of most important factors