The Dietary Exposure Assessment to Selected Food Additives and Contaminants for the GCC Countries Population

Dr. Husam Fahd Alomirah

Biotechnology Department, Kuwait Institute for Scientific Research
Overview

- Food Safety Challenges
- Risk Analysis
- Risk Assessment
- Surveillance of Mycotoxins and Antimicrobial Residues
- Estimation of Dietary Intake of Acrylamide, Selected Pesticides and Food Color Additives
- Getting Started on a Risk Assessment in GCC Countries
Food Safety Challenges

- New technologies
- Expanding trade opportunities and volumes
- Ethnic diversity in the population
- Changing eating patterns
- Increasing in competition (safer products for less money)
- Increasing knowledge and modern analytical tools (e.g. acrylamide)
Risk Analysis

- **Structured** way of examining and incorporating the wide variety of factors that impact on a decision-making process.

- Identify, assess and manage food-related health risks within a **structured** framework.
Risk Analysis

Risk Assessment
Science Based

Risk Management
Policy Based

Risk Communication
Interactive exchange of information & opinions concerning risks

WHO/FAO, 2005
Do we tell children to never cross a road because we believe it is too dangerous? 
No - we assess the risk and introduce suitable control measures, e.g. Always use the green cross code!
Elephant in the room...(or on their way)

An improperly conducted risk assessment is riskier than any risk that you may find...
Evidence derived from quality scientific data and information

- **Food Surveillance**
  - Continuous survey of microbiological and chemical contaminants (domestic and imported foods)

- **National Nutrition Survey**
  - 5 to 10 years

- **Food Composition Program**
  - Generate and compile nutrient composition data for national foods (composition tables and electronic databases)

- **Total Diet Study**
  - Dietary exposure (intake) to a range of food chemicals including food additives, nutrients, pesticide residues, contaminants and other substances.

- **Monitoring and evaluation**
  - Impact, effectiveness and appropriateness of implementing key food regulatory measures
Risk Assessment

- **Hazard identification**: The identification of known or potential health effects associated with a particular agent which may be present in food.

- **Hazard characterization**: The quantitative evaluation of the nature of the adverse effects associated with that agent (dose-response assessment)
Risk Assessment

- **Exposure assessment:** The qualitative and/or quantitative evaluation of the degree of intake likely to occur.
  - combining data on concentration in all food products with data on their consumption
- **Risk characterization:** Integration of the above into an estimation of the adverse effects likely to occur in a given population.
## Surveillance of Mycotoxins

<table>
<thead>
<tr>
<th>Contam.</th>
<th>Country</th>
<th>Year</th>
<th>Commodity</th>
<th>No. of samples</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afl. (M1)</td>
<td>UAE</td>
<td>1995</td>
<td>Human milk</td>
<td>445</td>
<td>99.5% were contaminated with levels ranging from 2 ppt to 3 ppb.</td>
</tr>
<tr>
<td>Afl. (M1)</td>
<td>Kuwait</td>
<td>2001</td>
<td>Dairy products</td>
<td>54</td>
<td>28% were contaminated with 6% above the MPL.</td>
</tr>
<tr>
<td>Afl. (M1)</td>
<td>Kuwait</td>
<td>2009</td>
<td>Milk, cheese and feed</td>
<td>445</td>
<td>80% were contaminated with 2-15% above the MPL.</td>
</tr>
<tr>
<td>Afl. (B1)</td>
<td>UAE</td>
<td>1999</td>
<td>Rice</td>
<td>500</td>
<td>64% of long grain rice and 32% of short grain rice were contaminated at levels ranging from 1.2 to 16.5 ppb.</td>
</tr>
<tr>
<td>Afl.</td>
<td>Oman</td>
<td>2002</td>
<td>Spices</td>
<td>105</td>
<td>45% were contaminated but did not exceed the MPL.</td>
</tr>
<tr>
<td>Afl., OTA, ZEA, DON</td>
<td>Qatar</td>
<td>2004</td>
<td>Food products</td>
<td>106</td>
<td>3.7-26.5% were contaminated in the range of 0.15-183 ppb.</td>
</tr>
<tr>
<td>Afl., OTA, STC, PAT.</td>
<td>Saudi Arabia</td>
<td>2009</td>
<td>Green coffee bean</td>
<td>30</td>
<td>43% were contaminated with a mean concentration of 29.7 ppb.</td>
</tr>
</tbody>
</table>

Maximum tolerance limit of M1 in human milk in European Union and USA (25 ppt) and Australia and Switzerland (10 ppt).

Maximum tolerance limit of B1=2 ppb, Total= 4 ppb, Feed= 20 ppb, M1=25 to 50 ppt
### Surveillance of Antimicrobial Residues

<table>
<thead>
<tr>
<th>Contaminants</th>
<th>Country</th>
<th>Year</th>
<th>Commodity</th>
<th>No. of samples</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetracyclines</td>
<td>Saudi Arabia</td>
<td>2000</td>
<td>Poultry products</td>
<td>33 broiler and 5 layer farms.</td>
<td>70% (broiler) and 60% (layer) of products were contaminated in these farms and at least one sample exceeded MRL/+ve farm.</td>
</tr>
<tr>
<td>Tetracyclines</td>
<td>Kuwait</td>
<td>2009</td>
<td>Dairy products, eggs and tissue samples</td>
<td>1517</td>
<td>5% of poultry and 18% of milk samples exceeded the MRL</td>
</tr>
<tr>
<td>β-lactams</td>
<td>Oman</td>
<td>2004</td>
<td>Milk</td>
<td>5 brand for 15 months</td>
<td>Antimicrobial activity present in all brands</td>
</tr>
<tr>
<td></td>
<td>Oman</td>
<td>2004</td>
<td>Goat and sheep meat</td>
<td>40</td>
<td>Almost all samples were contaminated but did not exceed the MRL.</td>
</tr>
<tr>
<td>Tetracyclines Streptomycin Chloramphenicol Sulphamethazene</td>
<td>Oman</td>
<td>2004</td>
<td>Goat and sheep meat</td>
<td>40</td>
<td>Almost all samples were contaminated but did not exceed the MRL.</td>
</tr>
<tr>
<td>β-lactams, Tetracyclines Sulfonamides Chloramphenicol</td>
<td>Kuwait</td>
<td>2007</td>
<td>Dairy products</td>
<td>1000</td>
<td>29% of fresh milk, 5% of pasteurized milk and a 10% of cheese samples exceeded the MRL.</td>
</tr>
</tbody>
</table>
Surveillance of other Contaminants

- Heavy metals
- Microbiological contaminants
- PAHs, OCPs, PCBs
- Migration of packaging materials
## Estimated Dietary Intake of Acrylamide

<table>
<thead>
<tr>
<th>Country</th>
<th>Subject/age group</th>
<th>Dietary Exposure (µg/kg bw/day) /Age group</th>
<th>Food Items/ Sample Analyzed</th>
<th>Food sample with highest mean concentration (µg/kg)</th>
<th>Food contributors to total exposure (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>United Arab Emirates (2004)</td>
<td>637 subjects (12-65 yrs.)</td>
<td>Mean (&gt;20 yrs.) 0.9-1.0 Mean (12-20 yrs.) 1.2 Mean (&lt;12 yrs.) 2.0</td>
<td>116</td>
<td>Potato chips = 1063 Deep fried food = 191 Bakery products = 132</td>
<td>Potato chips and crisps = 44% Pizza = 14% Fried grilled potatoes = 13%</td>
</tr>
<tr>
<td>Kuwait (2008)</td>
<td>5,490 subjects (2 mos-92 yrs.)</td>
<td>Total Population Mean 1.9 90th Percentile 3.9</td>
<td>800 (13 Food categories)</td>
<td>Potato chips = 572 Potato crisps = 332 Biscuits = 235</td>
<td>Potato chips = 32% Mixed dishes = 27% Potato crisps = 13%</td>
</tr>
<tr>
<td>Saudi Arabia (2009)</td>
<td>50 subjects (18-20 yrs.) 50 subjects (infants: first 6 months)</td>
<td>Mean (18-20 yrs.) 0.87 Mean (6 months) 0.075</td>
<td>30 (12 Food Categories)</td>
<td>Grilled eggplant = 950 Soluble coffee = 820 Korse omar cookies = 350</td>
<td>Arabian bread = 18% Soluble coffee = 13% Barely coffee = 11%</td>
</tr>
</tbody>
</table>
Estimated Dietary Intake of Selected Pesticides

- Dietary intake of pesticides residues in Kuwait, 1999.
- 11 Food groups, 664 food items.
- 6,700 subjects (5 months- >65 years) divided in 19 different population group.

<table>
<thead>
<tr>
<th>Pesticides</th>
<th>Food group with highest concentration levels (µg/kg)</th>
<th>Subject (age group)</th>
<th>Exposure (ng/kg bw/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 OPs</td>
<td>Grains 10-840 Composite dishes 10-330 Vegetables 50-200</td>
<td>30-39 years 15-19 years</td>
<td>62.6 52.3</td>
</tr>
<tr>
<td>3 OCs</td>
<td>Fruits 13-470</td>
<td>30-39 years 15-19 years</td>
<td>9.0 8.4</td>
</tr>
<tr>
<td>2 Carbamates</td>
<td>Fruits and Vegetables 63-5000</td>
<td>30-39 years 15-19 years</td>
<td>119.2 29.2</td>
</tr>
<tr>
<td>2 Benzimidazoles</td>
<td>Fruits 400-500</td>
<td>30-39 years 15-19 years</td>
<td>19.25 17.5</td>
</tr>
<tr>
<td>1 Phenylureas</td>
<td>Fruits 600</td>
<td>30-39 years 15-19 years</td>
<td>24.7 20.0</td>
</tr>
</tbody>
</table>

Total daily intake of these pesticides did not exceed the ADI per body weight set by the FAO/WHO 1993 but exceeded those of the USFDA.
### Estimated Dietary Intake of Food Color Additives

- Dietary exposure to artificial food colors in Kuwait, 2006.
- 9 food categories, 344 food items analyzed.
- 3,141 children, 5 to 14 years old children from 58 schools
- 9 permitted and 2 non-permitted artificial food color additives
- The average daily intake of tartrazine, sunset yellow, carmoisine and allura red were substantially higher than their ADIs

<table>
<thead>
<tr>
<th>9 Food Colors</th>
<th>Highest Concentration (mg/kg)</th>
<th>Highest Percentage Contribution</th>
<th>ADI (mg/kg bw)</th>
<th>Dietary Exposure (mg/kg body weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6 yrs M</td>
</tr>
<tr>
<td>Tartrazine</td>
<td>Chewing Gum 0.1-1189</td>
<td>Drinks and Juices 83%</td>
<td>0-7.5</td>
<td>8.31</td>
</tr>
<tr>
<td>Sunset yellow</td>
<td>Chips and Pufak 0.1-1088</td>
<td>Drinks and Juices 68%</td>
<td>0-2.5</td>
<td>9.84</td>
</tr>
<tr>
<td>Carmoisine</td>
<td>Chewing Gum 2.8-1949</td>
<td>Drinks and Juices 87%</td>
<td>0-4</td>
<td>8.81</td>
</tr>
<tr>
<td>Allura Red</td>
<td>Drinks and Juices 0.1-2335</td>
<td>Drinks Juices 42%</td>
<td>0-7</td>
<td>21.03</td>
</tr>
</tbody>
</table>
Needed Food Safety Related Sciences

- Microbiology
  - (classical, predictive and molecular),
- Molecular genetics and genomics,
- Toxicology (chemical, veterinary pharmaceutical and biological),
- Allergy and food intolerance,
- Risk assessment, management and communication,
- Novel food technologies and packaging
- Consumer sciences.
Getting Started on a Risk Assessment in GCC Countries

- Predict and monitor the behavior and fate of relevant known and emerging biological and chemical hazards,
- Develop and improve risk assessment and risk-benefit evaluation process,
- Develop surveillance tools to ensure the safety of consumed food
- Understand and address consumer concerns with food safety issues
Thank you for your attention
Hazard: A biological, chemical or physical **agent in**, or **condition of**, food with the potential to cause an adverse health effect.

Risk: = **Likelihood** of an adverse health effect \( \times \) **Consequence** of that effect.
Getting Started on a Risk Assessment in GCC Countries

- Assemble team
- Determine structural and operational chains of command and reporting mechanisms
- Evaluate and compile risks:
  - Phase 1: Review, Assessment, Measurement
  - Phase 2: Develop Risk Management and Compliance Structure
  - Phase 3: Implementation
  - Phase 4: Monitor