Identifying Potential Risks and Preventing Intentional Contamination: The Basics

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Food Defense - Preparing for the Coming Storm
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Security/ Safety/ Defense

- Food **Security**: System *sufficiency* – access to nutritionally adequate and safe food
- Food **Safety**: System *reliability* – reducing exposure to natural hazards/errors/failures
- Food **Defense**: System *resiliency* – reducing the impact of system attacks
- Food **Protection**: Current Safety/Defense “umbrella”
Agriculture Event Impacts

• Primarily an economic threat with major confidence in government impact

• Nationally distributed target with global trade significance
  – Local through national economic dislocations with rapid onset and slow recovery

• Cascading economic, psychological & sociological effects
  – UK and Dutch FMD outbreaks registered significant post-traumatic stress disorder rates
Food Event Impacts

• Both a significant public health and economic threat
  – Access to sufficient calories not a likely issue in developed nations, could be one in poorer nations

• Globally distributed target

• Psychological impact of personal threat vector for delivery of agents
  – “Will my cookie kill me” – as a Weapon of Mass Destruction threat
Food Contamination History

- Historical military weapon (troops/civilians)
  - Athenian poisoning of Kirrha (590 B.C.)
  - WWII Japan in China/Manchuria with *Bacillus anthracis*, *Shigella* spp, *Vibrio cholerae*, *Salmonella paratyphi*, and *Yersinia pestis*

- Terrorist/criminal acts in the U.S. and abroad
  - Rajneeshee cult contamination of ten salad bars with *S. typhimurium* (1984, 751 ill)
  - Lab technician poisoning of 12 co-workers with *Shigella dysenteriae* laced pastries (1996)
Grocery store worker accused of poisoning beef
Thursday, February 13, 2003 Posted: 5:04 PM EST (2204 GMT)
GRAND RAPIDS, Michigan -- A former supermarket employee was indicted on charges of poisoning about 200 pounds of ground beef with insecticide and sickening more than 40 people.

Italy on alert for water poisoner
Italian police have launched a search to track down a mystery poisoner who has been injecting a soapy liquid into plastic bottles of mineral water.

61 Students felled by rat poison in central China
Monday, September 29, 2003
Dozens of elementary school students and teachers in Hunan Province were hospitalized after ingesting rat poison with their school breakfasts in an apparent deliberate mass poisoning, state media said Sunday.

350 Iraqi Policeman Suffer Food Poisoning
October 11, 2006
BAGHDAD, Iraq -- Authorities arrested the head of the mess hall where at least 350 Iraqi policemen suffered food poisoning, and a military spokesman said Monday that it was likely the poisoning was intentional.
Intelligence on Food Terrorism

“Terrorist groups have a lesser interest in biological materials and are most interested in chemicals such as cyanide salts to contaminate food and water supplies”

CIA Testimony to Congress 2002

Documents Seized in Afghanistan (Tarnak Farms) Indicate Interest

NATIONAL CENTER FOR FOOD PROTECTION AND DEFENSE
A Homeland Security Center of Excellence
Global Food System Characteristics

• The most complicated supply chain known
• Optimized for rapid delivery of low cost product from all sources
• Perturbations at one point have cascading effects
• Excess capacity in the supply chain is very limited
U.S. Global Food System: Strength and Risk

2.1 Million U.S. Farms

30,000 U.S. Processing Sites

94,000 Foreign Processing Sites

935,000 Retail Food Outlets

19,000 Domestic Packers/Repackers

87,000 Foreign Packers/Repackers

224,000 Retail Food Stores

? Million Foreign Farms

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Significant Meat/ Poultry Exporters to U.S.

- >$1.25 billion
  - Australia, Canada
- >$700 million
  - New Zeeland
- >$100 million
  - Denmark, Uruguay
- >$10 million
  - Netherlands, China, Costa Rica, Italy, Nicaragua, Mexico
Food Defense Basics

• Senior management engagement
  – Recognize it as a real business risk
  – Approve the resources to begin addressing it
  – Commitment to food defense as one element of the continuity of operations (COOP) and other company plans

• Someone in the company needs to “own” food defense

• Food defense builds on food safety
Food Defense Basics

- Identify the food product/system
- Select the specific production system
- Map out the production system
- Identify potential system vulnerabilities & consequences
- Define potential interventions to mitigate vulnerabilities
- Prioritize interventions, implement, evaluate & repeat
Identify the Food Product?
**Identify the Food Product?**

- baking soda
- wheat gluten
- calcium propionate
- enzymes
- mono- and diglycerides
- diacetyl tartaric acid esters
- ethanol
- sorbitol
- polysorbate 20
- potassium propionate
- sodium stearoyl lactylate
- corn starch
- ammonium chloride
- ammonium sulfate
- calcium peroxide
- ascorbic acid
- azodicarbonamide

- Milk
- Water
- sodium citrate
- sodium phosphate
- artificial color
- acetic acid
- Enzymes
- Special Sauce
- Soybean oil
- distilled vinegar
- egg yolks
- sugar
- corn syrup
- spice extractives
- xanthan gum
- prop. glycol alginate
- sodium alginate
- caramel color
- Turmeric
- EDTA

- milkfat
- cream
- salt
- sorbic acid
- cheese culture
- soy lecithin
- starch
- pickles
- water
- HF corn syrup
- onion powder
- spice
- salt
- mustard flour
- sodium benzoate
- mustard bran
- hydrolyzed proteins
- paprika
- calcium disodium EDTA

- Cucumbers
- water
- Vinegar
- Salt
- Alum
- natural flavorings
- polysorbate 80
- turmeric

- USDA inspected beef

- lettuce
- dehydrated onions
- Grill Seasoning
- Salt
- Pepper
- cottonseed oil
- soybean oil

- National Center for Food Protection and Defense
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Just One Component - Flavored Beef Patties

• Ingredients
  – Beef, water, textured soy flour, soy protein concentrate, salt, wheat flour, dehydrated onion, flavorings, sodium phosphate, hydrolyzed soy protein, paprika, garlic powder, extractives of paprika

• System map – final processor
  – Raw materials in & their supply chains
  – Unit operations at the facility
  – Distribution system
Risk vs. Vulnerability

**Risk Assessment**
- An analytical process to provide information regarding undesirable events
- The process of quantification of the probabilities and expected consequences for identified risks

**Vulnerability Assessment**
- Systematic approach used to analyze the effectiveness of the overall (current or proposed) defense system

*Society for Risk Analysis Definitions*
Risk vs. Vulnerability

• Risk is the combination of the probability that an event will occur with the consequences
  – The aggressor must be identified
  – Probability is focused on the **threat**

• Vulnerability is the combination of the potential for an event occurring with the consequences
  – The aggressor must be defined
  – Probability is focused on the **consequences** occurring
Food System Event Consequences

- Public health (morbidity/mortality)
- Direct economic loss
  - Medical care/employment
  - Product disposal
- Indirect economic loss
  - Lost business & market access
  - Cascading infrastructure impacts
- Macro-economic loss – confidence & GDP
- One approach – BT Safety developed CMS
**Profile of the Food**

- Fats and oils
- Fish products
- Fresh eggs
- Fresh fish
- Fresh fruits and fruit juices
- Fresh meats
- **Ground Beef**
- **Ground Beef 2**

**Profile of the Agent and Event (Intentional)**

- Chemical Agents
  - Water soluble, heat stable
    - *Arsenic Trioxide*
    - Cyanide
    - *Ricin*
    - Saxatoxin
    - Organophosphate pesticides
    - Fluoroacetic acid
    - Amanitin

**Arsenic Trioxide.**

- **% of Product Contaminated**
  - 100%

- **Average Contamination Level**
  - (at point of consumption)
  - 1 LD50 per serving

- **Public Health Response Time**
  - 2 - 5 days

- **Impact Metric**
  - Health Impact

- **Affected Subpopulations**
  - General Public

Select whether the contamination incident was of food destined for Food Service, or Retail, or unknown.
Response Time
4 Hours from Trigger
Response Time
24 Hours from Trigger
Consequence Modeling Challenges – Food Contamination Agents

- Range of possible agents very large
  - Bacterial, chemical, toxins & radiological
- Agent interaction in food poorly understood
- Morbidity/mortality out of food poorly understood
- Food delivery vehicle effectively renders common agents to WMD level impacts
Consequence Modeling Challenges – Public Health Response

- Time to event recognition complicated by initial physician response
- State/local system with federal reporting and support not optimized for rapid response
- Foodborne illness outbreak responses highly variable across jurisdictions
Physician’s Ability to Diagnose Select Agents

• Based on case history presentations, correct diagnosis across 30 internal medicine programs:
  – Anthrax: 70%
  – Smallpox: 51%
  – Botulism: 50%
  – Plague: 16%

• After a select agent training module, diagnoses improved to >70%
The Challenge of Unusual Agents

Common Botulism Misdiagnoses

- Gullain-Barre
- Myasthenia gravis
- Stroke
- Intoxication with depressants
- Lambert-Eaton syndrome
- Tick paralysis
**Intervention Strategies**

- **Prevention** – can you eliminate the vulnerability?
- **Protection** – can you ensure that, if compromised, the consequences are still avoided?
- **Response** – can you respond fast enough to minimize the consequences?
- **Recovery** – can your company recover from the event?
Types of Aggressors

• Disgruntled insider
• Criminal
• Protestors
• Subversives
• Terrorists
Interventions - Staff

- Screening (pre-hire, post-hire)
- Daily work assignments
- Identification
- Restricted access
- Personal items
- Training
- Unusual behavior
- Staff health
Interventions - Visitors

- Categorize Visitors (contractors, drivers, customers, pest control, agencies, auditors, tours, reporters, etc.)
- Develop access policies specific to the potential vulnerability by visitor type & relationship
Interventions - Facilities

**External Focus**
- “Guns, Gates & Guards”
- Security of water and utilities

**Internal Focus**
- Chemical/material safety
- Computer security
Interventions - Systems

- “Hardened” processes
- Agent inactivation via processing or formulation
  - Agent/matrix interactions poorly understood
- Supply chain verification
- Detection systems
  - New technologies needed
- Supply chain control
Example Performance Goals - FBADS

• Sample testing time of $\leq 20$ minutes (prep, analysis, waste handling, and cleaning between analyses)
• A bench-top system for multiplexing up to 10 agents/organisms (current unit testing on two)
• The LOD goal for toxins $0.04$ nanograms per milliliter
• The LOD goal for microbial organisms is $1$ cell per gram
• False positive rate for each agent $\sim \leq 1$ in $1,000,000$
• Low false negative rate for each agent $\leq 1$ in $1,000$.
• Instrument should be moderately priced per unit and cheap to maintain (current unit estimated at $\$50,000$)
• Operation cost of consumables $\leq \$5.00$ per multiplexed sample test
Interventions – Risk Communication

• Plans needed for:
  – Actual events
  – Threats
  – Hoaxes

• Threats and hoaxes pose special considerations
  – Credibility of the threat or hoax vs. the company and government credibility
  – Existing examples show substantial firm consequences (Emulex – 60% stock collapse)
Financial Considerations

• Interventions have a cost
• In some cases interventions have secondary benefits that justify the cost
• In many cases interventions will be like insurance – investments that you hope to never cash in on prioritized by potential impact
• Do the interventions reduce or shift the risks?
• Consumers are expecting some investments
Consumer Perceptions

• Consumers believe terrorism events will occur in the near term
• Food attacks are the least anticipated, but consumers would spend the most on preventing
• Consumers place burden on the government first, industry a close second, for food defense
Consumers Believe Food Generally Safe, But Not From Terrorism

How confident are you that the food system is safe?

- Accidental Contamination
- Terrorism

Confident:
- Accidental Contamination: 64%
- Terrorism: 38%

Not Confident:
- Accidental Contamination: 36%
- Terrorism: 62%
Public Would Spend More for Food Defense and to Prevent Chemical-Biological Attacks

Percent of Spending to Protect Air Travel

<table>
<thead>
<tr>
<th>Category</th>
<th>Spending Percentage</th>
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<tbody>
<tr>
<td>Food</td>
<td>113.3</td>
</tr>
<tr>
<td>Bio/Chem</td>
<td>112.0</td>
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<tr>
<td>Other Trans</td>
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<td>Power</td>
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<td>Monument</td>
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<tr>
<td>Other</td>
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Spending on air travel protection = 100
# Food Safety Risks: Preventing System Failure

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**HACCP Domain**
## Food Defense Risks: Preventing Successful System Attack

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“Fighting terrorism is like being a goalkeeper. You can make a hundred brilliant saves but the one shot that people remember is the one that gets past you.”

Paul Wilkinson, Daily Telegraph, London, 1/92
“Defending the safety of the food system through research and education”