Fresh Cut Quality and Safety Workshop
14 September 2011

Topics in Good Agricultural Practices

Helpful overview resources
Looking Back at GAPs
Looking forward
- FSMA Produce Safety Regulations
- Compliance Assistance - Small Operations
- Research examples – Verifying audit criteria
Q&A
Food Safety Challenges

- Chemical
- Physical
- Biological
  - Microbial
  - Allergens
  - Toxins

Background Resources

For those that need to get up to speed


Gould et al. MMWR 60: 1197-1202

Key Facts Related to Fresh Produce

- Single commodity outbreak-related illnesses
  - Fruits and nuts – 1,755
  - Vine-stalk fruit vegetables – 1,622
  - Beef - 952

- Multistate outbreaks involving at least 7 states
  - 3/9 involved produce

- Most produce outbreak-related illnesses
  - Salmonella

Key Learning's from Outbreak Investigations and Environmental Assessments

- 2006 A – *E. coli* O157 near all 4 implicated ranches
  - Only one location matched case O157 profile
  - First strong linkage to wildlife source (feral pig)

- 2006 C – Matched O157 found in dairy and field
  - Cross-connections in water distribution system
Key Learning's from Outbreak Investigations and Environmental Assessments

• 2006 A – *E. coli* O157 near all 4 implicated ranches
  ➢ Only one location matched case O157 profile
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• 2006 B – Matched O157 found in dairy and field
  ➢ Cross-connections in *water distribution system*

• 2008 – *Salmonella Saint-Paul* in on-farm pond
  ➢ *Traceability* concerns/deficiencies highlighted

• 2010 – First *E. coli* O145 outbreak in produce
  ➢ Matched O145 profile in *multiple bags*

Why the Concern for Food Safety of Edible Horticultural Products?
**Changing Nature of Outbreak Profiles**

- **Outbreaks Then (Classic)**
  - Local outbreaks with gross mishandling on-site
  - Limited ability to link cases across U.S.
  - Animal foods and derivatives as main vehicles

- **Outbreaks Now (Recent)**
  - Multi-state outbreaks within a complex food chain
  - Enhanced recognition and response
  - National surveillance and PulseNet
  - Data-sharing with Health Canada and CFIA
  - Produce leads all foods in cases/100,000

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**Classic – Local and Regional Distribution**

**Recent – Multi-state/Multinational Distribution**
From the Beginning, Variable Risks Along the Supply-Chain were Recognized

Season -> Site Selection -> Pre-season field sanitation -> Variety
Pre-harvest sanitation -> In-season field sanitation -> Crop Management
Harvest Logistics -> Process Control Handling and Treatment

Reported outbreaks linked to FDA-regulated foods, by agent, 1996-2009 (N=532 outbreaks)

- Bacterial: 70.1%
- Chemical/Toxin: 17.5%
- Parasitic: 4.3%
- Viral: 4.1%
- Unknown: 4.0%

Source Credit: FDA/CFSAN 2011
Reported *illnesses* linked to FDA-regulated foods, by agent, 1996-2009 (N=29,750 illnesses)

- **Bacterial**: 69.8%
- **Chemical/Toxin**: 8.9%
- **Parasitic**: 14.3%
- **Viral**: 4.2%
- **Unknown**: 2.8%

Source Credit FDA/CFSAN 2011

Reported *outbreaks* linked to FDA-regulated foods by vehicle, 1996-2009 (N=532 outbreaks)

- **Produce**: 39.3%
- **Seafood**: 26.5%
- **Egg**: 16.4%
- **Dairy**: 8.1%
- **Processed foods**: 5.8%
- **Sprouts**: 3.9%

Source Credit FDA/CFSAN 2011
Reported *illnesses* linked to FDA-regulated foods, by *vehicle*, 1996-2009 (N=29,750 illnesses)

- Produce: 37.7%
- Seafood: 12.0%
- Dairy: 18.1%
- Egg: 24.3%
- Processed foods: 6.5%
- Sprouts: 1.3%

Source Credit FDA/CFSAN 2011

Types of produce associated with *outbreaks*, 1996-2009 (N=87)

- Berries: 17.2%
- Green onions: 32.2%
- Herbs: 10.3%
- Leafy greens: 10.3%
- Melons: 6.9%
- Tomatoes: 3.4%
- Others: 3.4%
- Unknown: 16.1%

Source Credit FDA/CFSAN 2011
### 78 Produce Outbreaks 1999-2010
#### Attribution by Commodity

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Year</th>
<th>Outbreaks</th>
<th>Illnesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lettuce/Romaine</td>
<td>19</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tomatoes</td>
<td>15</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Cantaloupe</td>
<td>7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Melons</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Honeydew</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Squash</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cucumber</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Raspberries/berries</td>
<td>7</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Sprouts</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basil</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basil or mesclun</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cilantro</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Celery</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Parsley</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green onions</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mango</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Table grapes</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jalapeño/Serrano</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow Peas</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snap Peas</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20</td>
<td>1638</td>
<td></td>
</tr>
</tbody>
</table>

Source: FDA CFSAN

### Where does Fresh-cut produce fit in the picture?

<table>
<thead>
<tr>
<th>Year</th>
<th>Outbreaks</th>
<th>Illnesses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2001</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2002</td>
<td>3</td>
<td>230</td>
</tr>
<tr>
<td>2003</td>
<td>3</td>
<td>125</td>
</tr>
<tr>
<td>2004</td>
<td>3</td>
<td>532</td>
</tr>
<tr>
<td>2005</td>
<td>4</td>
<td>255</td>
</tr>
<tr>
<td>2006</td>
<td>4</td>
<td>436</td>
</tr>
<tr>
<td>2007</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>20</td>
<td>1638</td>
</tr>
</tbody>
</table>

* Fresh-cut produce: fresh produce that has been processed by peeling, slicing, chopping, shredding, coring, trimming, or mashing, with or without washing or other treatment, prior to being packaged for consumption.

Source Credit FDA/CFSAN 2010
### Outbreaks – Domestic or Foreign Source?

<table>
<thead>
<tr>
<th>Animal source</th>
<th>Human source</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 <em>E. coli</em> 0157:H7</td>
<td>16 Cyclospora</td>
</tr>
<tr>
<td>28 <em>Salmonella</em> spp.</td>
<td>3 Hepatitis A</td>
</tr>
<tr>
<td>27 Domestic</td>
<td>2 Shigella</td>
</tr>
<tr>
<td>7 Foreign</td>
<td>8 Unknown</td>
</tr>
<tr>
<td>15 Unknown</td>
<td>12 Foreign</td>
</tr>
</tbody>
</table>

**Source**

- 27 Domestic
- 7 Foreign
- 15 Unknown

**Source**

- 1 Domestic
- 12 Foreign
- 8 Unknown

*FDA; Guzewich, J. 2007.*

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### Food Safety Depends on Prevention Programs with Multiple Hurdles

- **Persistence**
- **Growth**
- **Removal**
- **Disinfection**
- **Acute**
- **Survival**
- **Arrival**
- **Preharvest**
- **Postharvest**
Commodity-Specific GAPs and Food Safety Audit Checklists

- Melon
- Tomato
- Stone fruit
- Mushroom
- Lettuce & Leafy Greens
- Culinary Herbs
- Green Onions
- Sprouts
- Almond
- Citrus
- Strawberry
- Watermelon
- Blueberries
- Asparagus

Key Areas for All Scales of Farming and Shipping

- Water –
  - Preharvest & Postharvest
- Workers –
  - Hygiene & Training
- Waste –
  - Manure & Compost
- Wildlife –
  - Intrusion & Fecal
- Record-keeping
- Traceability
Key Grower Concerns

- Setback distances
- Water testing/assuring quality
- Mitigation of animal intrusion
- Impacts of pathogen testing
- On-farm verification requirements

Processors Have Extensive Training Materials, SOPs, SSOPs, Log Sheets, etc.
Pre-operational Inspections Day of Harvesting

- Equipment condition
- Health of Employees
  - Are all employees in good health?
  - Are employees wearing appropriate apparel?
  - Are employees following GAP’s?
- Evidence of any food safety issues
  - Animal intrusion
  - Injuries during harvest - Blood
  - Feces
  - Equipment condition and sanitation

Pre Harvest Assessments 1 to 7 days Prior to Harvest

<table>
<thead>
<tr>
<th>Evaluation of Potential Contamination Risks</th>
<th>YES or NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there evidence of wildlife or livestock intrusion in the block? (e.g. fecal matter, tracks of deer, pigs, sheep, cattle, domestic animals, rodents, reptiles, birds, insects etc.)</td>
<td>YES or NO</td>
</tr>
<tr>
<td>Are potentially contaminating materials (e.g. compost, manure, etc.) present in such manner as to pose a risk contamination to the fields to be harvested?</td>
<td>YES or NO</td>
</tr>
<tr>
<td>Are there any evidence of equipment or infrastructure compromised?</td>
<td>YES or NO</td>
</tr>
<tr>
<td>Is there any evidence that the irrigation delivery system being managed may potentially be compromised?</td>
<td>YES or NO</td>
</tr>
<tr>
<td>Is there any evidence that failure of any irrigation or drainage system will result in flooding or water stagnation that could result in potential contamination to the fields to be harvested?</td>
<td>YES or NO</td>
</tr>
<tr>
<td>Are there any other potential contamination risks present?</td>
<td>YES or NO</td>
</tr>
<tr>
<td>Has any equipment or irrigation system been cleaned or sanitized?</td>
<td>YES or NO</td>
</tr>
<tr>
<td>Person assessing Evaluation/Verification:</td>
<td></td>
</tr>
</tbody>
</table>
Field Foreman, Monitors, and Crews are trained to interact with CDFA Auditors and 3PA's

Short Frequent Training is Best
Metallic Bandages Set Off Metal Detectors in Packaged Product

Metal Detection in Salad Plant

Finger-Bobs Cover Bandage

Labor Force in CA Communicate in Many Languages and Dialects

- Mixtec
- Oaxaqueño
- Zapoteco
- Trique
- Chatino
- Nauhatl
- Mayan
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Sec. 105 - Standards For Produce Safety:

FDA “shall adopt a final regulation to provide for minimum science-based standards for those types of fruits and vegetables, including specific mixes or categories of fruits or vegetables, that are raw agricultural commodities, based on known safety risks, which may include a history of foodborne illness outbreaks.”
**Fresh Produce Safety (Section 105)**

- Within one year requires FDA to establish standards for safe production and harvesting of fresh produce
- Complied with USDA and state ag-departments
- 3 public hearings across U.S. during comment period
- Final Rule within one year of comment period

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**Food Safety Modernization Act**

- Allows the FDA to order a recall of tainted foods
- Increase inspections of domestic and foreign food facilities from those operations with the highest risk profiles (every three years)
- Requires farm and processor record-keeping
- Requires retailers to alert consumers on recalls
Ten-Point Critical Elements

- Management Commitment
- Food Safety Program
- Risk Assessment...includes wildlife
- Land Use Assessment
- Irrigation and Water Management
- Fertilizer, Soil Additives and Pesticide Use
- Personnel Hygiene...Training
- Equipment and Field Sanitation
- Field Foreign-Material Control
- Traceability

Monitoring

- The owner... is required to monitor the effectiveness of the facility’s preventive controls.
Corrective Actions

- The owner... is required to establish procedures to ensure that, if preventive controls are not properly implemented or are found to be ineffective: (a) all affected food is evaluated for safety; (b) all affected food is prevented from entering commerce; and (c) appropriate action is taken to reduce the likelihood of a recurrence.

Proper equipment and SSOP’s for sanitation
The owner... is required to verify that the facility’s preventive controls are adequate to control the hazards identified in the hazard analysis, that monitoring is being performed, that appropriate decisions about corrective actions are being made, and that periodic re-analysis of the plan is conducted. Verification is required to include environmental and product testing programs.
Laboratory Accreditation;
Direct Submission of Lab Tests to FDA (Section 202)

- Not later than 2 years after the date of enactment, FDA is required to establish a program for the testing of food by accredited labs. This laboratory accreditation program would encompass independent private laboratories; foreign laboratories; and laboratories operated by Federal, State, and local government agencies.

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**Produce Safety Alliance**

- Standardized multi-lingual education on **GAPs and Co-management**
- Resource for up-to-date scientific and technical information
- Support outreach for **FDA Produce Safety Rule**
- Identify knowledge gaps and to provide for continuous updating
- Steering committee to develop train-the-trainer materials

**Focus for Training is Directed to Smaller-Scale Operations**

- Strong focus on water quality
- Concerns for wildlife sources
- Adjacent non-crop influences
Produce Safety Alliance

- **Steering committee**: Cornell (lead) FDA, USDA, Universities, growers, shippers, produce trade alliances, USDA NRCS. AFDO
- **Key elements**: Standardized curriculum, information bank, Website, Educational Collaborative Network, Assessment outreach tools, Train-the-trainer

onfarmfoodsafty.org
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Salmonella enterica mitigation and disinfection efficacy on fresh tomatoes:
Influence of temperature, water quality and disinfectant type

Alejandro Tomás-Callejas, Gabriela López-Velasco, Francisco Artés, Francisco Artés-Hernández, Trevor V. Suslow
TOMATO POSTHARVEST HANDLING

- Water disinfection management
  - Sanitizer
  - Water temperature

Fruit pulp should be 5.5°C cooler than water temperature to prevent infiltration.

ON-SITE ASSESSMENTS OF TOMATO FACILITIES IN CA AND FL

Incoming Tomatoes
- Pulp temperature
  - 20 – 32°C

Dump tank
- > 300 NTU

Flume system
- 2 – 45 NTU

Measured Water Turbidity
OBJECTIVE

To assess the potential for *Salmonella enterica* cross-contamination and infiltration of tomatoes in relation to commercial sanitizers in a model washing system.

MATERIALS AND METHODS

- **Sanitizer**
  - Chlorine (as NaClO; 50 mg/L at pH 6.5)
  - Chlorine dioxide (ClO₂; 3 mg/L)
- **Contact time**
  - 2 min
- **Water quality**
  - Tap water
  - Tap water (160 NTU)
- **Water temperature**
- **Tomato temperature**

**CONDITION 1** (promote infiltration)
- T<sub>water</sub> = 22°C
- T<sub>tomato</sub> = 35°C

**CONDITION 2** (Fits guidance standard)
- T<sub>water</sub> = 35°C
- T<sub>tomato</sub> = 22°C
MATERIALS AND METHODS
Evaluation the potential for pathogen infiltration

1.
SURFACE STERILIZATION
Rubbing ethanol 70% + AgNO₃ 0.1% (1 min) + Rinse

3.
Sectioned transversally
Cut into sequential 5mm segments

4.
Homogenized BPW+rif
Enrich overnight at 37°C

5.
Streak on XLT4 + rif

CONCLUSIONS
- Assayed sanitizers might not control *Salmonella* infiltration
- Evidence of “passive” infiltration was observed.
- Water temperature is a key factor to prevent internalization
  - Dissolved and suspended solids add complexity
- The outcomes support the fresh tomato food safety standards and audit protocol

Suspended organic matter and dissolved solids greatly impact process water control.

**Sampling at the De-watering Stage May Improve Detection**

- Primary Verification Control in Process Water
- Secondary Verification Control on Product

**Table 1**

<table>
<thead>
<tr>
<th>Washing type</th>
<th>Washing step</th>
<th>CFU/mL</th>
<th>CFU/mL</th>
</tr>
</thead>
<tbody>
<tr>
<td>A NaClO</td>
<td>Prewashing</td>
<td>ND</td>
<td>A NaClO</td>
</tr>
<tr>
<td>Wash</td>
<td>ND</td>
<td>Wash</td>
<td>ND</td>
</tr>
<tr>
<td>Rinset</td>
<td>ND</td>
<td>Rinset</td>
<td>ND</td>
</tr>
<tr>
<td>Rinset</td>
<td>Concentrated</td>
<td>Rinset</td>
<td>Concentrated</td>
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<tr>
<td>OCl₂</td>
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<td>ND</td>
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<td>Rinset</td>
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<td>0.5</td>
<td>Rinset</td>
<td>0.5</td>
</tr>
<tr>
<td>Rinset</td>
<td>Concentrated</td>
<td>Rinset</td>
<td>Concentrated</td>
</tr>
</tbody>
</table>

ND: Not detected.
Summary – Uncooked produce is a significant contributor to the burden of foodborne illness

However…
- Illness to Total Servings per Year ratio is staggeringly small
- Consuming fresh produce remains the right message
- Prevention across the supply-chain is needed