

Cut Leafy Greens in Retail and Foodservice Establishments

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In this presentation, we will:

- Discuss the incidence of foodborne disease outbreaks and illnesses associated with leafy greens
- Examine the characteristics of leafy greens that contribute to the growth of pathogens
- Review pathogens associated with leafy green outbreaks
- Examine the effect of various intervention strategies on pathogens present on leafy greens
- Discuss control measures at the retail level and possible changes to the 2009 FDA *Food Code*

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Foodborne Disease Outbreaks and Illnesses Associated with Leafy Greens

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Foodborne Disease Outbreaks Associated with Leafy Greens – 1973 to 2006

- Analysis of 10,421 foodborne disease outbreaks reported between 1973 and 2006
- Approximately 502 (5%) were linked to leafy greens
 - **58.3% caused by norovirus**
 - **10.4% caused by *Salmonella***
 - **8.9% caused by *E. coli* O157:H7**

Source: CDC, Lynch et al. (2008) 4

Outbreaks/Illnesses Associated with Cut Leafy Greens – 1996 to 2006

- 21 confirmed multi-state outbreaks, 775 illnesses, and 5 deaths
- This data does not include outbreaks where produce was contaminated at point of service (retail, food service, or home)

Source: CFSAN Outbreak Surveillance Database 5

Outbreaks/Illnesses Associated with Cut Leafy Greens – 1996 to 2006

- *E. coli* O157:H7 associated with all but one of outbreaks
- *Salmonella* Newport associated with one outbreak in 2004
- Most commonly implicated products:
 - **Mesclun lettuce, Lettuce, Romaine lettuce, Spinach, Cabbage (coleslaw outbreak associated with contaminated cabbage)**

Source: CFSAN Outbreak Surveillance Database 6

Leafy Green Outbreaks Reported to CDC through the Foodborne Disease Outbreak Surveillance System – 1998 - 2006

- 23 foodborne outbreaks associated with leafy greens were reported
- Leafy greens accounted for 30% of all foodborne disease outbreaks associated with fresh produce

Produce Outbreaks 1998 - 2006

5 commodity groups make up 75% of produce-related outbreaks

| <u>Commodity</u> | <u>% produce outbreaks</u> |
|-------------------------------------|----------------------------|
| Lettuce/leafy greens | 30% |
| Tomatoes | 17% |
| Cantaloupe | 13% |
| Herbs (basil, parsley) | 11% |
| Green onions | 5% |
| Total % of 5 top commodities | 76% |



Fresh Cut Produce Outbreaks – 1998 -2006

- Romaine lettuce 3
- Lettuce 4
- Mixed lettuce 1
- Spinach 2
- Roma Tomatoes 2
- Tomatoes 1
- Mixed melons 2



Outbreaks Reported to CDC Involving Leafy Greens - 1998 - 2006

1995: 3 - *E. coli* O157:H7 - 105 cases
1996: 2 - *E. coli* O157:H7 - 68 cases
1997: 1 - Cyclospora - 12 cases
1998: 2 - *E. coli* O157:H7 - 6 cases
1999: 6 - *E. coli* O157:H7 - 86 cases
2002: 2 - *E. coli* O157:H7 - 53 cases
2003: 3 - *E. coli* O157:H7 - 60 cases
2004: 2 - Cyclospora - 95 cases
 1 - *Salmonella* - 79 cases
 1 - *E. coli* O157:H7 - 6 cases
2005: 1 - *E. coli* O157:H7 - 32 cases
2006: 1 - *E. coli* O157:H7 - 191 cases ¹⁰

Produce-Associated Outbreaks are on the Rise*

- Proportion of foodborne outbreaks associated with produce increasing over last 30 years
 - From less than 1% to 6% of all outbreaks
 - From less than 1% to 12% of outbreak associated cases
- Some produce items predominantly associated with particular pathogen
 - Lettuce and *E. coli* O157:H7
 - Tomatoes and *Salmonella*



* Slide from Dec 2005 presentation by Dr. Michael Lynch, CDC ¹¹

Per Capita Consumption vs. Proportion of Foodborne Outbreaks

- Used per capita availability of leafy greens as a proxy for leafy green consumption
- 1986 – 1995 vs. Previous Decade
 - Consumption of leafy greens increased 17.2%
 - The proportion of all foodborne disease outbreaks due to leafy greens increased 59.6%

Source: CDC, Lynch et al. (2008) ¹²

Per capita Consumption vs. Proportion of Foodborne Outbreaks

- 1996 – 2005 vs. Previous Decade
 - Consumption of leafy greens increased 9%
 - The proportion of all foodborne disease outbreaks due to leafy greens increased 38.6%
- **Conclusion:** The increase in proportion of foodborne disease outbreaks due to leafy greens cannot be fully explained by increased consumption.

Source: CDC, Lynch et al. (2008)
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Globalization of the Food Supply

- Rapid globalization of food production and trade has increased the potential likelihood of international incidents involving food contaminated with microbial or chemical hazards
- More countries are exporting to the U.S.
 - Some of these countries have poor internal control systems
 - Some are located in areas where biological hazards are greater
- There is no evidence that food imported into the U.S., as a whole, poses greater food safety risks than food domestically produced



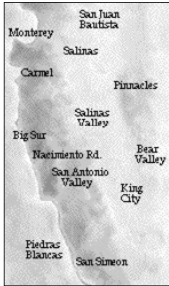
Changing Outbreak Profile

- | | |
|---------------------|---|
| • Classic | • Recent |
| – Obvious | – Widely dispersed |
| – Local | – Low attack rate |
| – Gross Mishandling | – Complex chain of production, processing, and distribution |
| | – Enhanced recognition and response |



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Lettuce and Spinach



- 22 leafy green associated *E. coli* O157:H7 outbreaks in the last 12 years
 - **Of the 12 that have been traced, all 12 indicate a California source of the leafy greens**
 - **Most, but not all, have traced to fields in the Salinas Valley**
- Fresh or fresh-cut lettuce or spinach implicated as outbreak vehicle

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Bagged Spinach & Shredded Lettuce Outbreaks 2006

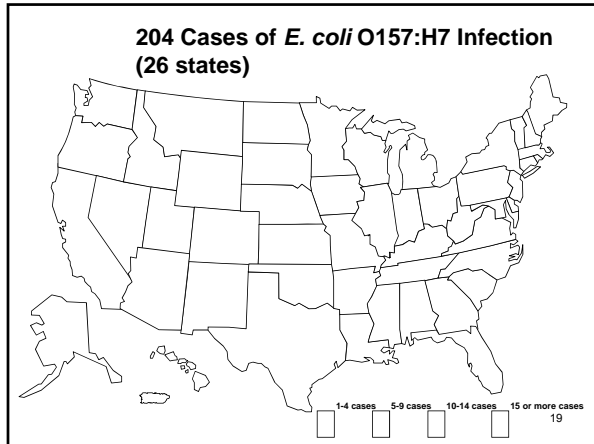


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2006 Spinach Outbreak

- Affected 26 states
- 204 cases of *E. coli* O157:H7
 - **31 involving Hemolytic Uremic Syndrome (HUS)**
 - **104 hospitalizations**
 - **3 deaths**
 - Two elderly women in WI and NE
 - A two-year-old in ID
- Traced to 4 fields in the Monterey and San Benito County, CA areas

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Public Health and Economic Costs of the 2006 Spinach Outbreak

- Public Health Cost Estimate
 - **Cost of reported illnesses**
 - A rough estimate of \$17.1 Million*
 - **Cost of unreported illnesses**
 - Unknown
- Economic Cost Estimated
 - **Between \$37 million and \$75 million**
 - **Roughly \$1 million per day of the outbreak**

*Source: USDA/ERS Foodborne Illness Cost Calculator

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2006 Spinach Outbreak - Conclusions

- Large, widespread outbreak of *E. coli* O157 infection
 - **Estimate 20 cases for each reported case (Mead, EID)**
 - **204 cases x 20 = ~ 4000 estimated cases**
- One lot of bagged fresh spinach implicated food vehicle
- Investigation is ongoing to define routes of potential contamination
- This was the 20th outbreak of O157:H7 linked to leafy greens in the last 10 years

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What went wrong?

- Cattle feces tested positive for the outbreak strain on one of the implicated ranches
- Possible transmission via feral pigs from cow pasture to spinach fields
- Local investigation continues
 - **Processing facility**
 - **Fields and ranches**

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Outbreak 2: Nov – Dec 2006
Cases in 5 states + Canada
Suspect cases in 3 additional states

Outbreak setting: Restaurant (Taco Bell)
First illness onset date: Nov. 20, 2006
Last illness onset date: Dec. 8, 2006

No. ill: 71
No. hospitalized: 53
No. HUS: 7
No. deaths: 0
Vehicle: Shredded Lettuce
Agent: *E. coli* O157:H7



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Outbreak 3: Nov – Dec 2006
Cases in 3 states – MN, IA, WI

Outbreak setting: Restaurant (Taco John)
First illness onset date: Nov. 27, 2006
Last illness onset date: Dec. 10, 2006

No. ill: 81
No. hospitalized: 26
No. HUS: 3
No. deaths: 0
Vehicle: Shredded Lettuce
Agent: *E. coli* O157:H7



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Contamination Sources

- Soil
- Irrigation Water
- Farm Workers
- Domestic and Feral Animals
- Processing
- Gross Mishandling (esp. at retail)



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E. Coli O157:H7 and Spinach



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Feral pig activity in spinach field



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E. Coli O157:H7 and Spinach



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E. Coli O157:H7 and Spinach



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**E. Coli O157:H7 and Leafy Greens
Potential sources of contamination**



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**E. Coli O157:H7 and Leafy Greens
Potential sources of contamination**



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**E. Coli O157:H7 and Leafy Greens
Potential sources of contamination**



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**E. Coli O157:H7 and Leafy Greens
Potential sources of contamination**



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**E. Coli O157:H7 and Leafy Greens
Potential sources of contamination**



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Characteristics of Leafy Greens

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Characteristics of Leafy Greens

- $\text{pH} \geq 5.8$; $\text{Aw} \geq 0.99$
- According to 2005 FDA *Food Code*, Interaction Table B, leafy greens are considered a PHF (TCS Food)
- Cutting or shredding leafy greens:
 - **Alters physical barriers (waxy cuticle) and biochemical processes**
 - **Provides opportunities for microbial invasion of tissue**
 - **Provides sufficient water and nutrients to support growth**

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Characteristics of Leafy Greens



- Sensory panels and experiences from lettuce and spinach lettuce outbreaks show the sensory quality of fresh and bagged leafy greens is at least a week and often much longer
- The processor's shelf life of bagged, fresh cut, RTE leafy greens is generally 12 – 16 days
- Spoilage organisms do not outgrow and spoil the leafy greens before pathogens increase at abuse temperatures
- Pathogens grow but the leafy greens are still visually acceptable

Pathogens Associated with Leafy Green Outbreaks and Illnesses

Outbreaks Associated with Leafy Greens

• **Microorganisms most often implicated:**

- *Escherichia coli* O157:H7
- *Salmonella* species
- *Cyclospora cayetanensis*

Common Hazards Associated with Cut Leafy Green Outbreaks and Illnesses

- *E. coli* O157:H7
 - Attaches in 60 – 90 minutes, especially at cut surfaces and openings such as stomatal pores, and forms biofilms
 - Can internalize at cut and tears
 - Studies have shown that once *E. coli* O157:H7 becomes internalized in cuts in the plant tissue, it becomes inaccessible to chlorinated or other chemical washes and can survive the disinfection or sanitizing process

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Common Hazards Associated with Cut Leafy Green Outbreaks and Illnesses

- *E. coli* O157:H7
 - No complete effective way to remove or destroy the pathogens once they are attached or internalized, except by irradiation (not approved for fresh produce yet)
 - Infective dose is estimated to be 10 – 100 organisms
 - Severity and long term sequelae (HUS & Reiter's Syndrome) counter health benefits of eating fresh produce

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Common Hazards Associated with Cut Leafy Green Outbreaks and Illnesses

- *Salmonella* Newport
 - Attaches in 60 – 90 minutes and forms biofilms
 - One of a few strains of types of *Salmonella* that is adapted to grow on leafy greens
- Norovirus (at retail)

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Effect of Intervention Strategies

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Intervention Strategies

- Contamination in the field or packing house cannot be 100% prevented and washing steps cannot remove 100% of contamination.
- Water with sanitizer added is used to eliminate 3 – 4 logs pathogens in solution and prevent them from attaching to the leafy greens.
- Once bacteria are attached or internalized, there is no fully effective mitigation strategies to remove or destroy contamination.
 - **Chemical sanitizer rinses only provide a 1 – 2 log reduction at best**
 - **Irradiation is effective, but isn't approved yet**

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Intervention Strategies

- There is no kill step.
- Use of other controls have not been proven effective at preventing pathogenic growth on cut leafy greens
 - **Modified Atmosphere Packaging (MAP)**
 - **Vacuum (anaerobic) Packaging**
 - **Competing microflora (Standard Plate Count (SPC) of 5-8 million)**
- MAP packages stored at improper temperatures supports *E. coli* O157:H7 isolates' ability to survive gastric acid.

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Intervention Strategies

- Multiple barriers including implementation of GAPs and temperature control for safety at the point of sale or service need to be in place to mitigate the impact of any contamination that does occur
- Refrigeration at $\leq 41^{\circ}\text{F}$
 - Effectively limits the growth of pathogens such as *E.coli* O157:H7, *Salmonella* spp., and *Listeria monocytogenes*
 - Promotes a general die-off over time no matter where the leafy greens were contaminated

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Handling Cut Leafy Greens From the Processing to Retail

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Guidance and Initiatives

- 2004 FDA Produce Safety Action Plan
 - Intended to minimize the incidence of foodborne illness associated with fresh produce
- 2006 – Commodity Specific Initiatives
 - Commodity Specific Food Safety Guidelines for the Lettuce and Leafy Greens Supply Chain - 1st Edition (April 2006)
 - Lettuce Safety Initiative – August 2006
 - Tomato Safety – June 2007
 - Leafy Greens Safety Initiative – October 2007

<http://www.cfsan.fda.gov/~dms/lettsup.html> 48

Guide to Minimize Microbial Food Safety Hazards for Fresh Fruits and Vegetables (latest version: February 2008)



<http://www.cfsan.fda.gov/~dms/prodgui4.html> 49

FDA Guidance

Good Agricultural Practices (GAPs)

- Not Regulations
- Cannot be enforced
- For farms and packing sheds



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FDA Guidance

- Recommendations Address:
 - **Personnel health and hygiene**
 - **Training**
 - **Building and equipment**
 - **Sanitation operations**
 - **Fresh-cut produce production and processing controls from product specification to packaging**
 - **Storage and transport**
 - **Recordkeeping**
 - **Recalls and tracebacks**



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Why Refrigerate?

- In the FDA *Guide to Minimize Microbial Food Safety Hazards of Fresh-cut Fruits and Vegetables*, subparagraph VII (C)(3) and paragraph VIII (D), FDA recommends that finished, fresh-cut produce be held, stored, transported, and displayed at 40°F or lower.
- It is common industry practice to refrigerate cut produce to preserve the crispness and to prevent browning, decomposition and sliminess from spoilage organisms.
- With no “kill step” for fresh produce, refrigeration is for quality and safety.

Why Refrigerate?

- Changing state and local retail food codes and ordinances to mandate that cut leafy greens be maintained at 41°F or less will keep *E. coli* O157:H7 (46.4°F) and *Salmonella* spp. (44.6°F) from proliferating.
- Storage at temperatures above 41°F can negate pathogen reductions achieved from prior washing in cold or warm chlorinated water and allow surviving pathogens to multiply.
- Outcome of the 2008 Conference for Food Protection – Storage at ambient air temp of 45°F or less
- Changes will be in the 2009 *Food Code*

Other Requirements at Retail

- Prevention of Contamination
- No Bare Hand Contact with RTE food
- Employee Health
- Handwashing
- Proper Sanitization
- Food source

Summary

- FDA is committed to improving the safety of produce.
- Success in improving the safety of produce requires an acceptance that the problem is more than theoretical; it is real.
- Success in improving the safety of produce requires collaboration and cooperation between Federal, State, and Local Governments, Trade Associations, Industry and Consumers.

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Questions?

- Special Thanks To Michelle Smith, Ph.D. and Shirley Bohm

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