Assessing Contributing Factors for *Salmonella* I 4,[5],12:I:- Outbreak Investigations Associated with Pork and Rotisserie Chicken

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Outline

- Intent of root cause analysis
- Two investigations associated with pork products and agency actions (2015-2016)
- Multistate investigation associated with rotisserie chicken

Importance of Root Cause Assessments to Prevent Illness

- Root cause analysis:
  - Assist in identifying solution to eliminate food safety hazard
  - Establish a logical problem-solving process for future application
- Assessments provide insight into risk factors that lead to contaminated food and illness
- Supports policy development targeting food safety gaps

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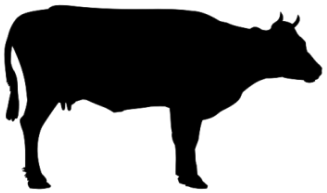
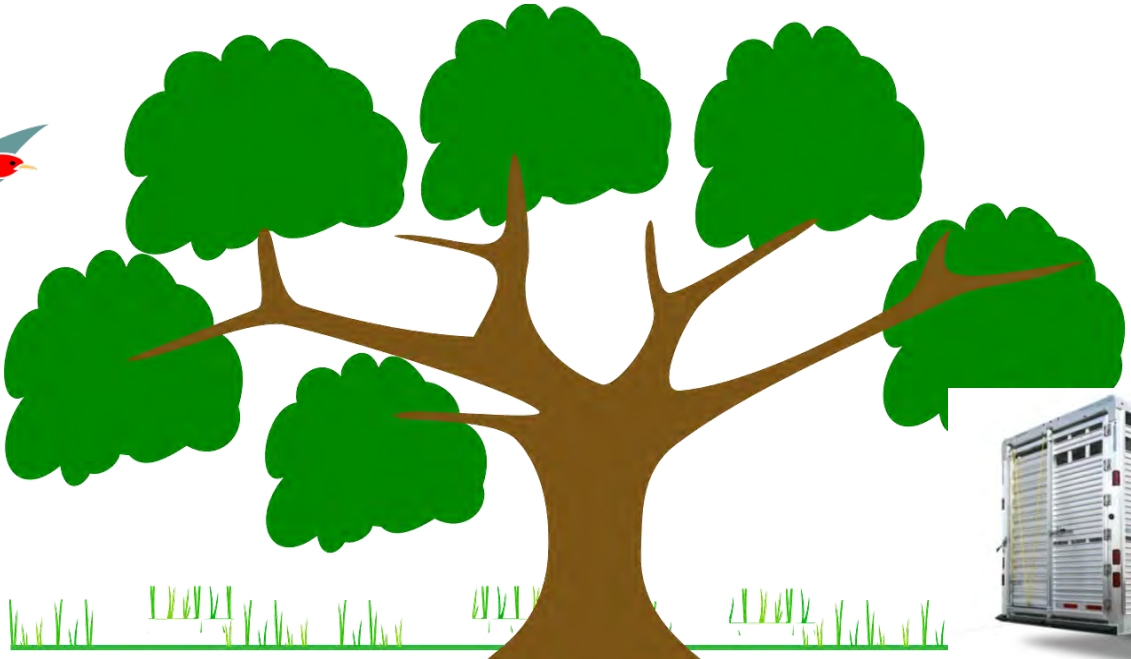
Root Cause Comprises Multiple Factors from "Farm to Fork"

Wildlife

Herd Additions





Contaminated feed

Environmental exposure

Sanitary dressing issues

Transmission during lairage

Transport factors

Product handling

Livestock commingling

Consumer and customer-related factors

FSIS Directive 8080.3 Provides Guidance for Addressing Root Cause

- Identifying contributing factors, including addressing potential system failures, is an objective of a foodborne illness investigation

- Working to update directive to include coordination of foodborne-related illness root cause assessment with USDA-APHIS

Assessment Requires Understanding of Supply Chain and Processes

- **On-farm:** Contaminated feed, wildlife and environmental exposure, animal husbandry practices, herd/flock additions
- **Transport:** Contaminated trucks, sale barn contacts and exposures, other mixing of animals from different sources, environmental stress, lowered livestock immunity which can increase disease transmission
- **Slaughter and Processing:** Contamination, environmental harborage, transmission during lairage, sanitary dressing issues, storage and transport
- **Retail and Consumer:** Potential temperature abuse, cross-contamination, undercooking, high-risk populations

General Questions FSIS Addresses to Identify Food Safety Breakdowns

- Does establishment have a Sanitation SOP and HACCP Plan to prevent and control hazards?
- Where in the process have critical control points (CCPs) been identified?
- Are CCPs monitored at the proper frequency, as directed in HACCP plan?
- What corrective actions taken in response to CCP deviations?
- What interventions are used at these points and are they scientifically valid?
- Is recordkeeping adequate to demonstrate food safety system is working as designed?

Information FSIS Seeks During Assessment at Slaughter

- Are animals handled humanely with minimal stress?
- Is carcass handled in a sanitary manner to prevent contamination (e.g. free of fecal material or ingesta)?
- Is carcass temperature properly controlled to minimize outgrowth of bacteria that are present?
- How is compliance monitored to ensure food contact surfaces are regularly cleaned and disinfected?

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Questions FSIS Investigates at Processing

- Does the establishment take measures to prevent and control hazards on incoming ingredients?
- When raw or not-ready-to-eat (NRTE) product is labeled with cooking instructions, have these been validated?
- For RTE products, is the lethality step sufficient to eliminate or adequately reduce pathogens?
- Do cooked products meet cooling guidance criteria to prevent bacterial outgrowth?
- Are measures taken to prevent contamination of cooked products after lethality steps?

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Overview of *Salmonella* I 4,[5],12:i:-

- Monophasic variant of *Salmonella* Typhimurium with antigenic and genotypic similarities
- 2000: Multidrug resistant isolates first observed in Europe; first published documentation of serotype in Japan
- 2010: Resistance emerged in the U.S; ampicillin, streptomycin, sulfonamide, tetracycline (ASSuT)
- Serotype is one of top 5 associated with human salmonellosis
- Worldwide, isolates associated with swine, poultry, eggs, cattle, rodents, and wild birds

Overview of *Salmonella* I 4,[5],12:i:-, continued

- Serotype not known to be consistently associated with illness in livestock or poultry
  - A recent study suggests it can be persistently shed by swine and may be associated with clinical enteritis in younger pigs (Weaver et al., Preventive Veterinary Medicine, 2017)
- FSIS testing has detected the ASSuT resistance phenotype at low or very low levels in all species (swine, turkey, beef, chicken) in exploratory, baseline, HACCP and cecal sampling
- Outbreaks in humans have been linked to pork and chicken consumption and live animal contact

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2015 *Salmonella* I 4,[5],12:i:- Investigation Associated with Pork

- 192 case-patients from 5 states (AK, CA, ID, OR, WA); 188 infected with *Salmonella* I 4,[5],12:i:-
  - Illness onset: 4/25/15 – 9/25/15
  - 17% (30/180) hospitalized
  - 76% (94/123) consumed pork
- Resistance: ASSu in 1 and ASSuT in 20 clinical isolates
- FSIS traceback identified Establishment A (Est. A) as source of pork or whole hogs for case-patients attending pig roasts
  - Notice of intended enforcement issuance
  - FSIS recall: 116,262 pounds of whole hogs

Intensified Sampling

- Intensified sampling at Est. A during the outbreak:
  - *Salmonella* I 4,[5],12:i:- isolated from all cecal samples, several carcass swabs and pre-operational environmental swabs
    - 93% (14/15) isolates had ASSuT AMR profile
    - All *Salmonella* I 4,[5],12:i:- isolates indistinguishable from the main outbreak PFGE pattern
    - Sampling results revealed insanitary conditions at Est. A, leading to a recall expansion of 523,380 pounds of pork products
  - Serotypes Infantis and London were also isolated

2016 WA *Salmonella* I 4,[5],12:i:- Investigation Associated with Pig Roasts

- 15 case-patients
  - Illness onset: 6/1/16 – 8/10/16
  - 13/14 (93%) with pork exposure
  - Same as 2015 outbreak strain; ASSuT in 3 clinical isolates
- Epidemiological and traceback data led to Est. A implicated in 2015 investigation
  - Public health alert; recall of 11,658 pounds of whole hogs
  - ASSuT pattern in 3/5 (60%) carcass swab samples
  - Samples were positive for the same 2015 outbreak strain

Lessons Learned

- Insanitary conditions at Est. A suggest potential environmental harborage of the outbreak strain
- Safe food handling to avoid cross contamination and proper cooking to prevent foodborne illness
- Further study needed on survivability and persistence of this serotype to better understand its characteristics

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Efforts Towards Roaster Pig Food Safety

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Validation Study for Cooking Roaster Pigs

- In collaboration with academic researchers
  - Conduct thermal image mapping for cooking roaster hogs
  - Thermocouples will be inserted throughout the carcass to determine hot and cold/cool spots
- Evaluate various sizes/weights of pigs
  - Similar to pigs implicated in recent outbreaks
  - Sample collection during Summer of 2017
- Plans to use data generated from the study to develop guidance for safe cooking of roaster pigs
- Considering submission to the Conference for Food Protection (CFP) on roaster hogs

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2016-2017 West Coast *Salmonella* I 4,[5],12:i:- Investigation Associated with Rotisserie Chicken

- 63 case-patients from 13 states (West Coast focus)
  - Illness onset: 7/5/16 – 1/24/17
  - 27% hospitalized
  - 88% case-patients report consuming chicken, including 60% case-patients who reported consuming rotisserie chicken products from 11 chain B locations

- WGS ResFinder indicates ASSuT or tetracycline resistance

FSIS Actions

- On 10/9/16, FSIS issued a public health alert for rotisserie chicken salad produced from 8/26/16 to 9/2/16 from a WA retail chain B location

- In December 2016, FSIS personnel visited 4 chain B stores for observation of practices
  - Noted opportunities for undercooking and cross-contamination

- Findings shared with chain B corporate personnel

Actions Taken and Future Efforts Towards Rotisserie Chicken Food Safety

- Chain B retrained employees on temperature measurement and log keeping
- Adjust holding temperatures in coolers to minimize ice on chicken so starting temperatures for cooking are more consistent
- Worked with suppliers to standardize chicken size
- Explore use of wireless thermometer system
- FSIS plans to submit best practices to CFP as guideline to avoid undercooking and cross-contamination during preparation of rotisserie chicken

Conclusions

- Investigations involving *Salmonella* I 4,[5],12:i:- may have characteristics that enhance its environmental hardiness or heat resistance
- Cross-contamination and undercooking were identified as contributing factors in rotisserie chicken and pork products, leading to targeted interventions
- Published research suggests that this pathogen is predominantly associated with livestock and poultry, across broad species range

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State and local public health partners

One Team, One Purpose -- Protecting Public Health and Preventing Foodborne Illness

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