Interventions for a Beef Safety System

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Executive Director, Beef Safety Research
National Cattlemen’s Beef Association
Beef Industry’s Commitment to Safety

- History to the approach
- Focus 880,000+ cattle at 35+ processing facilities

This began efforts to develop multiple interventions

- Stocker
- Feedlot
- Packer
- Processor
- Retailer
- Foodservice
- Cow/Calf
- Seed Stock

800,000+ 2,700 35 280,000,000+

85% 95%
Safety Interventions & Best Practices

Organic acid wash
Acidified sodium chlorite
Steam/thermal pasteurization
Carcass microbial mapping
Steam vacuum
Hide wash


Cattle washing
On farm ecology
Sodium chlorate
Vaccine
Neomycin
Direct fed microbials
Transportation and lairage

1993
Blue Ribbon Task Force

1997
Founding of BIFSCo

1998

2000

2002

2004

2006

2008

1993

Best Practice evolution and Safety Summits

2003
E. coli Summit

2006
BIFSCo cited as model for other industries

2008
Video of BPs
Beef Industry’s Commitment to Safety

- Interventions (at plant, part of post-harvest)
  - Hide on wash
    - Water
    - Water w/chemical
- Sprays
  - Organic acids - lactic, acetic
  - Acidified sodium chlorite
- Temperature
  - Hot water
  - Steam vacuum
  - Steam pasteurization
Carcass Interventions

Multiple-Hurdle Technology

- Knife Trimming
- Pre-Evisceration Wash
- Chemical Dehairing
- Chlorine Dioxide Rinse
- Acetic Acid Rinse
- Steam Vacuuming
- Final Wash
- Steam Pasteurization
- Hot Water Wash

Colorado State University
Center for Red Meat Safety
Beef Industry’s Commitment to Safety

- Many options available
- Industry’s dedication to implementation
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- Though post-harvest interventions are successful in minimizing pathogen loads on carcasses some organisms can get through the system.

- Therefore, there is a need for pre-harvest interventions to further reduce incoming microbial load on cattle.
Safety Interventions & Best Practices

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Beef Industry’s Commitment to Safety

- Key knowledge learned for pre-harvest
  - Hides
  - Transfer to the carcass
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- Interventions (at plant pre-harvest)
- Live wash
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- Key knowledge for pre-harvest
- Environment
Prevalence of food-borne pathogens in soil samples collected from beef feedyards

- E. coli O157
- Salmonella

Legend:
- clean loadout
- dirty loadout
- home pens
Prevalence of food-borne pathogens in air samples collected from clean loadout areas and dirty, dusty loadout areas in beef feedyards.

![Graph showing the prevalence of E. coli O157 and Salmonella in clean versus dirty areas.]

- **E. coli O157**:
  - Clean: 60%
  - Dirty: 10%

- **Salmonella**:
  - Clean: 20%
  - Dirty: 10%
Fecal prevalence for *E. coli* O157:H7

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<thead>
<tr>
<th>Pen</th>
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<th>2</th>
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## Hide prevalence for *E. coli* O157:H7

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Beef Industry’s Commitment to Safety

- Interventions (prior to plant pre-harvest)
  - Direct Fed Microbials

- Approved for animal health and performance, NOT as a pre-harvest intervention for pathogens
Cumulative proportion of steers that were positive culture-positive for *E. coli* O157:H7 by treatment group and by sampling period.
4 Year Cumulative Summary
Reduction of E. coli O157 in Beef Feedlot Cattle Using NP 51

Percent positive for E. coli O157

- Control
- NP 51
Beef Industry’s Commitment to Safety

- Interventions (prior to plant pre-harvest)
  - Phages
    - Viruses that target specific bacteria
    - Have been widely used in Eastern Europe in place of antibiotics
    - Invade targeted bacteria, replicate, kill the bacterium, but not other bacteria
E. coli O157:H7 strain 933 (log_{10} CFU/g digesta)

- Control
- Phage

Tissue:
- Rumen
- Cecum
- Rectum

P < 0.05
Beef Industry’s Commitment to Safety

- **Interventions (prior to plant pre-harvest)**
- **Sodium chlorate**
  - Phages target and invade specific bacteria
  - Chlorate kills bacteria that have the enzyme nitrate reductase only
  - Kills *E. coli* O157:H7 and *Salmonella* but not other bacteria
E. coli O157:H7 in cows

- 933 control
- 933 chlorate
- 86-24 control
- 86-24 chlorate
- 6058 control
- 6058 chlorate
Sodium chlorate reduces O157:H7 populations in experimentally infected cows.

Did not change rumen or gut function.
Beef Industry’s Commitment to Safety

- **Interventions (prior to plant pre-harvest)**
  - Neomycin
    - Labeled for use in cattle
    - ‘treatment and control of colibacillosis (bacterial enteritis) caused by *Escherichia coli*’
    - In-feed and in-water preparations
    - 10 mg/lb/day for up to 14 days
    - 1-day withdrawal period
O157 Reduction in Prev
• Feces – 98.2%
• Hides – 95%
Theuninck - Cargill

O157 Reduction in Prev
• Feces – 100%
• Hides – 78.9%
Belk - CSU
Beef Industry’s Commitment to Safety

- Interventions (prior to plant pre-harvest)
- Vaccines

Fecal prevalence of *E. coli* O157:H7

- Controls
- SRP Vaccinates

Trt P = 0.03
Day P <.0001
Field Efficacy Study 2: 2007

Measure of effect | Magnitude
--- | ---
Vaccine Efficacy(%) | 86% reduction
Concentration | 98% reduction
Performance | No effect ($P > 0.60$)

Both comparisons associated with $P \leq 0.02$
The most important finding of this study was that vaccinated cattle were less likely to be colonized at the TRM.

Vaccinated cattle were 98.3 percent less likely to be colonized by *E. coli* O157:H7 in TRM (odds ratio = 0.014, *P*<0.0001).
Efficacy of Dose Regimen and Observation of Herd Immunity from a Vaccine against *Escherichia coli* O157:H7 for Feedlot Cattle†

R. E. PETERSON,† T. J. KLOPFENSTEIN,† R. A. MOXLEY,‡ G. E. ERICKSON,† S. HINKLEY,‡ D. ROGAN,§ AND D. R. SMITH‡

Vaccine efficacy of receiving one, two, or three doses of vaccine was 68, 66, and 73% respectively, compared with cattle in pens not receiving vaccine.

Unvaccinated cattle housed with vaccinated cattle were 59% less likely to shed *E. coli* O157:H7 than cattle in pens not receiving vaccine, likely because they benefited from herd immunity.
Cattle in the vaccinated region were 62% less likely to shed *E. coli* O157:H7 than cattle in the unvaccinated region \((p=0.002)\)

Within commingled pens vaccinated cattle were 58% less likely to shed *E. coli* O157:H7 than unvaccinated cattle \((p=0.005)\)
Beef Industry’s Commitment to Safety

- **Prevalence**
  - What was available
  - Expensive
  - Labor intensive
  - Sensitivity

- **Load/quantification**
  - Now available and used
  - Allows for routine testing and quantification
  - More cost efficient
  - Sensitivity
Beef Industry’s Commitment to Safety

- Interventions, both pre- and post-harvest are vital parts of a system of hurdles in beef production and processing.

- No “silver-bullet”, and because of the multi-hurdle system, one intervention does not have to be
Decontamination

- These procedures **cannot** be applied to replace...
  - Good manufacturing practices such as:
    - Equipment hygiene during production
    - Employee hygiene and hand washing
    - Sanitation – before, during and after operations
  - Proper chilling:
    - proper time & temperature
    - product and carcass spacing to insure air flow
  - Continuous employee training for proper technique
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- Avenues of implementation
  - BIFSCo
    - Beef Industry Safety Summit
    - Executive Summary
  - Best Practices
    - www.bifsco.org
    - www.beefresearch.org
Interventions for a Beef Safety System

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