STEC O157 in cattle: the facts, fiction, and challenges for pre-harvest control

Dr. David Renter

E. coli Conference 2012, Greenbelt, Maryland
STEC O157 in cattle:

- **facts** – highlights on STEC O157 epidemiology and ecology
- **fiction** – explain some complexities and “myths” that circulate(d) about STEC control
- **challenges for pre-harvest control** – mitigation opportunities that may lead to practical solutions
STEC O157 in cattle:

- STEC O157 epidemiology and ecology … complexities…. control
Pre-harvest: What do we know? What can we do?

- Epidemiology and ecology
  - Refined knowledge of factors ("risk factors") that may affect STEC
  - Translate to mitigation opportunities (?)
  - i.e., how does the knowledge of risks or risk factors lead to solutions/control?
O157 (and other STEC) are:

– Enteric bacteria .... shed (transmitted) in feces
  – Fecal/oral transmission

– Found in/on healthy cattle and a variety of other species

– Found in a variety of cattle environments; ubiquitous among herds
Pre-harvest: What do we know?

- Epidemiology and ecology (fecal shedding of STEC O157)
  - Variability
  - Seasonality
  - Production setting/system
  - Diet
  - Water
  - Wildlife
Variability – pre-harvest fecal prevalence

Day of harvest – 44 feedlot pens: Range (0-80%) Overall ~ 30%

Why? Mitigation?

Renter et al, 2008
Variability – “super shedders”

Most cattle shed STEC O157 at low concentrations

Some shed O157 at high concentrations; ~ $>10^4$ CFU/g feces

Associated with overall fecal prevalence, transmission, contamination of hides, carcasses, etc.

Why? Mitigation?
STECC O157 – Seasonal Effects

- Much higher in summer
  - Cattle feces/hides
  - Ground beef
  - Human illness

- Practical mitigation opportunities?

Williams et al, 2010
Shift in Cow Feed May Make Beef Safer

By JANE E. BRODY

Microbiologists at Cornell University have found a way to virtually rid cattle of harmful strains of E. coli bacteria, including the bacteria that have caused scores of deaths and sickened thousands of consumers of undercooked hamburgers.

Their studies, described in today's issue of the journal Science, demonstrated that the grain-based feedlot diet usually fed to cattle before slaughter fosters growth of E. coli bacteria, some of which can cause disease. Among the dangerous strains that can survive when cattle are fed grain is E. coli O157:H7, the most deadly E. coli known.

The findings were met with enthusiasm by both the cattle industry and food safety experts.
Grass-fed vs. Grain-fed
Grass vs. Grain – STEC O157

- Evaluate the original literature – many Internet summaries confuse generic *E. coli* with STEC O157
- Numerous studies associate grain feeding with increased fecal concentration of generic and acid-resistant *E. coli*
- In contrast, forage-based diets have been most commonly associated with increased shedding levels or increased duration of shedding of O157

From Dr. David Smith

http://extension.wsu.edu/vetextension/ec/Pages/Factsheets.aspx
Most (>80%) ranch calves (on grass) have been exposed to *E. coli* O157 prior to weaning, and all ranch herds have *E. coli* O157.

Laegreid et al, 1999
After accounting for age, researchers have not seen a difference in STEC fecal shedding between cattle in extensive grass pastures or in confinement.

Renter et al, 2004
Organic vs. Natural vs. Conventional production systems

O157 Fecal Prevalence

Organic (n=552)  Natural (n=506)  Conventional (n=322)

Reinstein et al, 2009
Distiller’s Grains – byproduct of ethanol production

Cereal Grains
(e.g. Corn)

Ethanol

Distiller’s Grains (DG)
Distiller’s Grains – a good quality cattle feed

- Concentrated in fiber, fat and protein
- Useful to cattle as a protein or energy source
- Fed at different inclusion levels
  - 10-40% …largely affected by corn price
Distiller’s Grains (DG) – STEC O157 shedding

- Positive association
- Effects are apparent in several studies
  - Roughly 2 fold increase
  - Dosage effects?
- Mechanisms unclear
  - Mitigation opportunities?

![Bar chart showing E. coli O157 Prevalence (%) vs. Level of DG (0%, 20%, 40%)]

Jacob et al, 2010
Cattle Diet and STEC O157

- Diet associated with fecal shedding
  - Grain vs. forage
  - Feeding distiller’s grains
  - Grain type, processing method, etc.
- Mechanisms (exact) remain unknown
  - May provide opportunities for mitigation – practical solutions?
Other Species/Sources

Other ruminants
- Deer, sheep, goats

Other mammals
- Opossum, raccoon, coyotes, cats....
- Feral swine (spinach outbreak)

Birds
- Starlings, turkey

Flies
- Transmission to/from cattle

Primarily in/around cattle
Pre-harvest: What do we know? What can we do?

- Epidemiology and ecology
  - Some common misconceptions
  - Better understanding of risks and risk factors
  - Thus far, few, if any, opportunities for practical production system changes that are known to reduce pathogens
Pre-harvest: What can we do?

- Epidemiology and ecology, still opportunities
  - Variability among groups and individuals
  - Dietary mechanisms
- Targeted interventions (e.g., vaccine)
  - Technology/efficacy exist
  - Time for adoption?
Thank you!

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