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BEEF CATTLE RESEARCH COUNCIL

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Beef Cattle Research Council - E. coli O157:H7

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E. coli (short for *Escherichia coli*) is a species of bacteria naturally occurring in digestive tracts and are needed to keep animals healthy. There are hundreds of different strains. Most strains are beneficial or harmless to animals, including humans. A few strains can be dangerous to people. *E. coli* O157:H7 is one strain of the dangerous strains and is shed in the manure of many warm-blooded animals, including deer, geese, dogs and cattle. *E. coli* O157:H7 is harmless to most animals but is dangerous to humans, especially to those with an immature or weakened immune system, because it produces a toxin that can cause severe illness. People can become infected by consuming undercooked meats or water that was contaminated by *E. coli* O157:H7. Cow-calf producers, feedlots, transporters, processors, retailers and consumers all play an important role in reducing or eliminating incidences of *E. coli* O157:H7.

Sections

Human Exposure to E.coli 0157:H7

E. coli 0157:H7 is a resilient bacterium that is very common in the environment. It can survive and replicate in a wide range of conditions, including with or without the presence of oxygen, and despite changes in pH and temperature. There are four major routes of human exposure:

E. coli 0157:H7 is naturally occurring in many animals. It is not harmful to cattle, but can cause illness in humans.

- Consuming undercooked meats that were contaminated at slaughter or during processing or preparation
- Consuming fresh fruits and vegetables irrigated or washed with contaminated water
- Exposure at fairs in which livestock are present, or at petting zoos
- Consuming water from contaminated water sources, such as lakes, rivers, ponds, swimming pools, or wells that are not properly maintained or where water quality regulations are not enforced

Impact on the Canadian Beef Industry

Because cattle, like most other animals, shed *E. coli* 0157:H7 through feces, and beef can become contaminated from hides and equipment during slaughter and processing, the entire industry takes steps to prevent incidences of contamination. This requires substantial investments in research, infrastructure and production practices.

"Shedding" - the excretion of a pathogen from the body.

Product recalls, triggered by suspected contamination of *E. coli* 0157:H7, can cost the industry millions of dollars. Recalls are typically very extensive. The identification of a single positive result causes an entire batch of product to be recalled. These recalls are expensive to packers, processors and retailers and costs are inevitably passed on to producers. In addition to direct costs, analysts recognize that any food safety incident, whether real or perceived, that cause concern in consumers result in reduced prices and lost sales for 3-6 months.

Research works to find practical, economical and effective solutions that can implemented to reduce or prevent *E. coli* O157:H7 and other pathogen contamination throughout the production chain.

Producers' Role

The number of infected cattle herds across Canada, and the rate of infection within those herds are presumed high. In one study, prevalence of *E. coli* O157:H7 in Saskatchewan feedlots ranged from 0% to 57.5% (Vidovoc and Korber, 2006). The majority of beef calves (87.5%) were found to have the O157 antigen prior to weaning, suggesting that they have been exposed to the pathogen at least as a calf (Laegreid and Keen, 2004). Therefore, it is recommended that producers assume that their herds are infected.

The relationship between decreased shedding of *E. coli* 0157:H7 in live animals and food safety of meat products is unclear

Reducing the spread of *E. coli* 0157:H7 at the cow-calf and feedlot levels is important, yet very difficult to effectively manage. Continued research to discover on-farm strategies that consistently decrease *E. coli* 0157:H7 in live cattle is identified as a high priority for the industry. The relationship between decreased shedding of *E. coli* 0157:H7 and food safety is unclear.

Much research has been done to understand *E. coli* O157:H7 in cattle in feedlot settings. This is because feedlots are the last home for most cattle before slaughter, and because cattle are grouped in feedlots, making data easier to gather.

Through numerous feedlot studies, the origin and behaviour of *E. coli* O157:H7 in feedlots is well known, including:

- Cattle with *E. coli* O157:H7 in their digestive tract show no clinical signs.
- *E. coli* O157:H7 is found in cattle populations across the country, in every environment.
- Seasonal differences in shedding have been noted. Shedding peaks in summer and early fall.
- Most infections in cattle are temporary, lasting approximately 4 weeks, and the numbers of *E. coli* O157:H7 shed by infected cattle can vary widely, even within one day.
- Infections come and go within animals. An infection may not produce a strong enough immune response to prevent subsequent infections.

Basic Husbandry

Ensuring pens have adequate, clean bedding with proper water drainage will minimize the potential for pathogens. Shipping animals to the packer that are clean, with little or no tag (clumps of mud and manure on the hide), may minimize contamination of the carcass at the processor level. Transport trailers should be cleaned and adequately bedded before animals are loaded.

Unfortunately, research has shown that regular pen cleaning and frequent, aggressive cleaning of water troughs does not have any effect on rates of *E. coli* O157:H7.

Cattle Diets

Although *E. coli* O157:H7 has been found in feed, no association between presence in feed and the pathogen's prevalence in live animals has been found.

Vaccine

A vaccine for cattle has recently been developed to aid in the reduction of *E. coli* O157:H7 shedding in cattle. The vaccine is licensed for use in Canada, requiring three doses and a 60 day withdrawal period before slaughter. It typically costs $3 per dose.

The vaccine works by immunizing cattle against the proteins that are expressed on the surface of E. coli O157:H7 cells. These proteins act as a receptor in intestinal walls, allowing the bacteria to colonize. The vaccine has been shown to reduce shedding, but reduced shedding in live animals may not sufficiently reduce *E. coli* O157:H7 contamination on meat products. There is no evidence that immunization against *E. coli* O157:H7 with the current vaccine will provide any cross protection against the other potentially hazardous pathogens, such as *Campylobacter*, *Listeria*, *Salmonella*, or non-O157 STEC strains of *E. coli*. It is also well known that not all cattle respond equally to a vaccination program.

The vaccine was developed through collaboration between the University of British Columbia (UBC), Alberta Research Council (ARC), the University of Saskatchewan's Vaccine & Infectious Disease Organization (VIDO) and Bioniche, which holds the rights for worldwide commercialization of the vaccine. The BCRC contributed to funding early research.

Water protection

Cow-calf producers and feedlots should manage their water drainage from cattle pens to ensure the water does not directly flow into surface streams and creeks, or areas close to lakes or wells.

Irrigation canals and sensitive riparian areas along streams and rivers should be fenced or lined with buffer strips to reduce the access of cattle to the water. Completely limiting the access of cattle to surface water on grazing lands is impractical and wild ruminants (deer, moose) aquatic mammals (beavers, musk rats) and birds (geese, ducks) that occupy the ecosystem can also carry the bacteria.

Untreated water drained directly from livestock operations should not be used to irrigate vegetable crops that are not cooked prior to consumption.

Processor Responsibility

Food safety is paramount to packers, and they invest heavily in methods to mitigate pathogens including *E. coli* 0157:H7. Current practices in abattoirs and processing facilities include numerous and diverse methods, which vary slightly across facilities. Packers diligently ensure their practices comply with, if not exceed standards under hazard analysis critical control point (HACCP) plans. The methods used by processors are proven to be very effective in reducing the pathogen load in the end product, and contamination in end-products is extremely rare.

Hide wash

Once the animal has been killed, it moves through a high-pressure, hot water rinse (hotter than 70^{o}C)to kill pathogens on the hide before the hide is removed.

Careful dressing procedures

Workers take care to ensure that the hair side of the hide does not contact the carcass during hide removal. Careful evisceration ensures that the digestive tract is not perforated, so that gut contents do not contact the carcass surface.

Vacuum steaming

Once the hide is removed a steam vacuum is used to remove bacteria and visible fecal contamination by delivering continuous steam at 7 to 10 psi at 88-94^{o}C while simultaneously vacuuming the area. The equipment is continually sanitized while in use.

Carcass trimming

Any visible contamination on a carcass is removed using knives and discarded.

Carcass washes

Once any visibly contaminated spots have been removed, carcasses move through washes. These washes may contain naturally occurring organic acids, such as lactic acid, to kill pathogens. Carcasses also pass through high temperature steam cabinet to pasteurize the surface.

Chilling

Carcasses are aged in coolers at temperatures that prevent pathogen growth.

Fabrication

Workers clean gloves, knives and other equipment frequently to maintain hygiene, and tools, equipment and facilities are thoroughly cleaned between shifts.

Irradiation

Irradiation has been proven to be a safe and effective means of destroying all pathogens, but has not been approved for use on meats in Canada. It is approved for use in the U.S.

Beef Research School: What Is Irradiation?

Click here to learn more about irradiation, which is available on the BCRC Blog.

Retail, Foodservice, and Consumer Responsibility

Safe food-handling

It is unknown how many *E. coli* 0157:H7 organisms are required to cause illness, but it is known that the number is relatively low. Proper food handling, transport, storage, retail display and preparation will prevent the growth of pathogens and cross contamination with other foods and work surfaces. It is important that these safe food-handling guidelines are followed:

- Keep meat refrigerated or frozen. Thaw in the refrigerator.

- Keep raw meats and the cutting boards and utensils used to prepare them separate from other foods
- Avoid cross-contamination by thoroughly wash work surfaces, equipment, utensils and hands after touching raw meats
- Cook ground beef to an internal temperature of 160^{O}F or 71^{O}C
- Keep foods hot before consuming
- Refrigerate leftovers immediately

Cook to appropriate temperatures

E. coli 0157:H7 can contaminate the surface area of beef during slaughter. The bacteria will only be found on the surface, not down within the muscle fibers. However, if contaminated meat is cut or ground, the bacteria can be carried down into the meat, or mixed throughout ground meat. Therefore, ground products, such as hamburgers or sausage, must be cooked to an internal temperature of 160^{O}F or 71^{O}C, which will completely destroy the bacteria. A meat thermometer should be used to ensure internal temperatures have been reached before consuming.

Current Research

1. Examining the Decontamination of Beef Trim by Spraying it with Lactic Acid Solution –determine the minimum amounts of lactic acid solution that must be delivered onto fat, cut muscle and membrane covered surfaces of beef trim to obtain the maximum reductions in numbers of *E. coli* O157.
2. Examining the Impact of Wheat Distillers Grains on the Shedding of *E.coli* 0157:H7 – determine the relationship between incorporation of wheat distillers dried grain solubles and shedding of *E. coli* O157:H7 in naturally colonized commercial feedlot cattle; and determine the impact of fecal pH on levels and persistence of *E. coli* O157:H7 in the feedlot environment
3. Use of low dose e-beam irradiation to reduce *E.coli* O157, non O157 (VTEC) *E.coli* and *Salmonella* viability on meat surfaces – predict whether e-beam treatment of beef carcass surfaces can yield pathogen-free ground beef patties of acceptable quality.is evaluating the sensitivity of different strains of *E.coli* O157:H7

Feedback

Feedback and questions on the content of this page are welcome. Please e-mail us at info@beefresearch.ca.

This topic was last revised on February 29, 2016 at 09:02 AM.

Related Fact Sheets

Do Distillers' Grains Increase E. coli Shedding?
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/do-distillers-grains-increase-e-coli-shedding-67)**

E-beam Treatment to Improve Beef Safety
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/e-beam-treatment-to-improve-beef-safety-63)**

Effectiveness of a Vaccine and Direct-fed Microbial for Controlling E.coli O157:H7 in Canadian Feedlot Cattle

Examing Antimicrobial Sprays Applied to Beef Trim
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/examing-antimicrobial-sprays-applied-to-beef-trim-64)**

Exploring potential benefits of prebiotic, probiotic, and symbiotic use in cattle
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/exploring-potential-benefits-of-prebiotic-probiotic-and-symbiotic-use-in-cattle-143)**

Impact of Carcass Processing Procedures on Food Safety
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/impact-of-carcass-processing-procedures-on-food-safety-157)**

Investigating the impact of E. coli 0157:H7 in soil on water quality
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/investigating-the-impact-of-e-coli-0157h7-in-soil-on-water-quality-71)**

Seeking a Solution to E. coli 0157:H7
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/seeking-a-solution-to-e-coli-0157h7-72)**

Seeking Better Vaccines for Livestock
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/seeking-better-vaccines-for-livestock-31)**

Storage life of vacuum packaged beef
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/storage-life-of-vacuum-packaged-beef-65)**

Training New Food Safety Researchers
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/training-new-food-safety-researchers-62)**

Why do some cattle shed more E. coli 0157:H7?
View Web Page **(http://www.beefresearch.ca/factsheet.cfm/why-do-some-cattle-shed-more-e-coli-0157h7-68)**

Cooking of Beef Burgers
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Cleaning Mechanical Tenderizing Equipment
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Cooking Mechanically Tenderized Steak
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Developing and Testing of a Prototype Automatic Beef Trim Sampler
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