

A Basic Look at *E. coli* O157:H7

Without a doubt, safety is “job one” for the beef industry. That’s why cattle producers and beef processors have devoted millions of dollars to improving beef safety. In fact, since 1993, the beef industry has spent more than \$28 million on beef safety research, outreach and education through The Beef Checkoff. Including private industry efforts, collectively, the industry spends more than \$350 million annually on improving beef safety.

Much of that work has focused on reducing the incidence of *E. coli* O157:H7 contamination in beef products. *E. coli* O157:H7 can be linked to beef as healthy cattle can harbor the organism in their gastrointestinal tracts and shed it in their feces. If beef becomes contaminated at harvest or processing, and is not cooked properly, it can potentially lead to severe illness. An *E. coli* outbreak linked to ground beef in 1993 created an impetus for the beef industry to focus strategically on methods to control this pathogen.

E. coli O157:H7 is a specific strain of *E. coli* (short for *Escherichia coli*) that produces toxins that can damage the lining of the human intestine. It was first recognized as a disease-causing organism in 1982. Since that time, knowledge surrounding *E. coli* O157 has significantly increased resulting in a decrease in the number of people affected by this pathogen. Unfortunately, however, approximately 70,000 cases of human illness due to *E. coli* O157:H7 still occur in the United States annually, according to the Centers for Disease Control and Prevention (CDC).

Background

Generic *E. coli* is the name for certain members of the bacterial family *Enterobacteriaceae*. The *E. coli* group literally has hundreds of members, or strains. Some strains live in animals’ intestines, helping digestion, keeping harmful bacteria under control and producing and processing important vitamins. Humans need *E. coli* and other kinds of bacteria within the intestinal tract to remain healthy. In fact, *E. coli* represents approximately 0.1 percent of the total bacteria within an adult’s intestines.

Some virulent strains of *E. coli*, however, including *E. coli* O157:H7, can cause illness in people when present in the intestine. People with weak immune systems, such as young children or the elderly are more susceptible to bacterial infection from *E. coli* O157:H7.

E. coli O157 can be found almost anywhere. Animals, including sheep, cattle, horses, goats, elk, pigs, deer, rabbits, opossums, raccoons, dogs, poultry, wild birds and houseflies, can all be hosts to *E. coli* O157. When an animal has *E. coli* O157 within its intestine, it typically “sheds” the organism through its feces. As a result, the bacteria can be found throughout the environment.

Once consumed by humans, the bacteria move through the digestive tract and settle in the intestine and can lead to illness. Examples of ways humans might introduce *E. coli* O157 into their bodies include eating contaminated, undercooked meat; drinking unpasteurized milk or fruit juice; or consuming produce that has been cross-contaminated. Other sources of exposure might be less obvious, such as swimming in feces-contaminated water, or touching your mouth after playing on grass containing feces from infected geese.

E. coli O157 can be linked to beef as cattle are one of the primary hosts. Cross-contamination can occur when cattle are harvested and a hide with cattle feces comes in contact with a carcass or meat products. The beef-processing sector implements several layers of safety interventions and works cooperatively with government inspectors to prevent this from occurring, but limited instances of contamination still occur. Proper consumer and end-user handling, including cooking beef to a proper internal temperature of 160°F, will kill the bacteria and prevent foodborne illness.

E. coli O157 continues to be a challenge to the beef industry as it continually adapts to different conditions and environments. The organism can remain viable for months at a time in both feces and soil. It can survive and replicate in both standing and free-flowing water. Unlike many other bacteria, *E. coli* O157 can survive and replicate in aerobic and anaerobic environments. It can respond and adapt to differences in environmental chemicals, pH, and temperature in remarkable ways. Worldwide, virulent strains of *E. coli* also are emerging, and while they are not as prevalent as O157, they have the potential to cause foodborne illness. Researchers are working to better understand these other strains and their potential impact on beef safety.

The Future of Preventing *E. coli* O157 Contamination

Existing safety intervention strategies are primarily focused on the harvest and beef-processing sectors as they initially offered the greater potential for improving food safety. With the advent of Hazard Analysis Critical Control Point (HACCP)-based inspection in the 1990s, the concept of applying “multiple hurdle” interventions gained momentum and significant safety improvements were achieved. To increase the efficacy of post-harvest safety technologies, and to apply another layer of safety, researchers have for some time been examining the application of pre-harvest interventions at the production level to reduce pathogen loads on cattle presented for slaughter. Most of the experiments evaluating pre-harvest safety interventions have focused on the feedlot level as it is a production stage that is more intensely managed and is also the stage in beef production immediately before harvest.

According to researchers, it is possible to broadly organize options for pre-harvest control of *E. coli* O157 into two categories

1. Modifications of existing management strategies, such as changing a feed ration or cleaning water troughs more frequently
2. Targeted intervention strategies or technologies, such as an *E. coli* O157 vaccine or feed additives

Because *E. coli* is ubiquitous and has a unique ability to adapt, research to date has failed to identify specific management practices that consistently reduce *E. coli* prevalence. That’s why research in the pre-harvest sector continues to be a top priority and is ongoing. Targeted technologies, including *E. coli* vaccines and other control strategies, are not yet broadly available on a commercial basis as many are still being researched, validated, or are in the regulatory approval process.

The beef industry has been cited as a model for other commodities in how to address food safety challenges. A proactive approach at the processing level has earned dividends by reducing the number of foodborne illnesses due to *E. coli* O157:H7.

Continuing this strategy with the advancement of pre-harvest research will only serve to enhance consumer confidence in beef safety. Many pre-harvest interventions are still experimental in nature, but as promising technologies and management strategies continue to be researched and developed, it will be important for beef producers to understand how they might be incorporated into their management practices.

To learn more about pre-harvest beef safety research, visit www.bifsc.org or www.beefresearch.org.

Sources:

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