



PURDUE UNIVERSITY

Food Safety Issues

E. coli O157:H7 - Concerns and Challenges for the Next Millennium

Richard H. Linton, Ph.D.
Food Safety Extension Specialist

Arun Bhunia, Ph.D.
Molecular Food Microbiologist

Knowledge to Go
Purdue Extension

1-888-EXT-INFO

Situation:

During the last decade, an organism called *E. coli* O157:H7 has surfaced as a very prominent and dangerous food contaminant. Presence of this organism in foods has led to nationwide food recalls, illnesses, and deaths. *E. coli* O157:H7 is particularly dangerous because it has a low infective dose (as few as 10 cells) and can lead to severe disease complications, including death. This type of bacteria usually originates from the intestines of cattle and can contaminate any food that comes into contact with animal waste. While several foods can be contaminated with *E. coli* O157:H7, ground beef, vegetables (sprouts, lettuce) and unpasteurized fruit juices (apple cider) are of particular concern. Ground beef can be contaminated during the time of slaughter and fruits/vegetables can be contaminated on the farm if they come into contact with fecal material. More recently, *E. coli* O157:H7 has been associated with contaminated drinking water.

In an effort to protect the public, *E. coli* O157:H7 is now considered an adulterant in ground beef. If the organism is found in ground beef, the ground beef must be destroyed. For unpasteurized fruit juices, a new label is required that now informs the public of the potential health risks.

What we know:

E. coli O157:H7 belongs to a group of bacteria called enterohemorrhagic *Escherichia coli*. Many people are curious about how *E. coli* O157:H7 was named. The "O" and the "H" represent cellular and flagellar antigens, respectively, that are associated with the bacterial cell. These antigens are numbered depending on certain characteristics and this information is used to classify or name the bacteria.

Escherichia coli is commonly found in the intestinal tract of warm-blooded animals. Approximately 10% of the bacteria found in the human intestine are made up of *Escherichia coli*. Most *Escherichia coli* bacteria are harmless and help in the wellness of human health. Fortunately, only a few types of *Escherichia coli* are harmful including *E. coli* O157:H7.

E. coli O157:H7 is dangerous because of the disease that it can cause. For the healthy host, disease symptoms can range from flu-like symptoms to bloody diarrhea. However for the immuno-compromised host, the disease can lead to a disease called hemolytic uremic syndrome that can lead to kidney failure and sometimes death. The immuno-compromised hosts that are most vulnerable are infants, children, and the elderly. Another concern of the infection caused by *E. coli* O157:H7 is that the infective dose may be as low as 10 cells. This is quite different compared to other disease causing organisms where the infective dose may be in excess of a million cells.

The organism can be associated with any food that may potentially come in contact with animal or human fecal materials. The most likely source of contamination is the meat slaughter facility or milking operations. However, fruits and vegetables may also be contaminated during growing, harvest, and transportation.

Unpasteurized apple cider has been implicated as a source of contamination and illnesses. In this outbreak, investigators believe that apples fell to the ground where they were contaminated with animal manure. After contamination, the apples were pressed into cider and no heat treatment was used to destroy bacteria and ensure safety. Furthermore, these bacteria have a unique ability to survive in acidic food environments such as apple cider (pH 3.8-4.2). More recently, the drinking water supply was contaminated during a summer fair in New York. The source of contamination for this outbreak was also animal manure.

Prevention and control of *E. coli* O157:H7 needs to be implemented from the farm to processing to consumption. Many prevention techniques are being studied to prevent and/or reduce contamination on the farm including manure treatment, water treatment, and animal feeding operations. After the farm gate, care is being taken to ensure that transportation vehicles and processing equipment are cleaned and sanitized effectively. Informing the consumer is also part of prevention. Recommendations for

handling meat are located on the packages of most raw meat products. This label helps educate consumers on thawing and cooking safely, avoiding cross contamination, and the importance of handwashing. Unpasteurized fruit juices must also contain a label with the following information: "WARNING: This product has not been pasteurized and, therefore, may contain harmful bacteria which can cause serious illness in children, the elderly, and persons with weakened immune systems."

These methods may reduce the risk of contamination, however, the only assurance of safety is through heating. Fruit juices need to be heat pasteurized and hamburgers need to be cooked thoroughly to assure that they are safe.

What we don't know:

The sudden emergence of *E. coli* O157:H7 is a bit puzzling. Prior to the 1980's, the organism was not commonly associated with foods. Today, we hear about *E. coli* on a regular basis. When consumers are asked what they prefer in the foods that they eat, quality and taste often rank very high. Many consumers prefer a juicy hamburger that is a bit red on the inside or a glass of unpasteurized apple juice. While these foods may taste better, they also offer a higher risk to consumers when compared to a safely cooked hamburger and heat pasteurized juice.

Several methods, other than heat processing, are being studied to reduce and eliminate *E. coli* O157:H7 in food. Some of these methods include irradiation, ozone, UV-light, high pressure and organic acids. Due to cost restrictions and/or limited research, the exact effectiveness of these treatments is not known. Further research is needed.

Another challenge for *E. coli* O157:H7 is detection. Since the organism can cause illness at very low levels, microbiologists need to be able to detect very low levels of cells. This has proven challenging to microbiologists and several methods are currently being investigated. Ideally, microbiologists would like to have a test that is rapid, accurate, inexpensive, and can

detect as little as one cell. Several researchers are working on optimizing microbial detection, but we are far from reaching our goal. In addition, technology needs to be improved where scientists can track the bacteria from farms to processing plants to humans to effectively control the spread of this dangerous pathogen.

There are several recommendations for reducing the risk of *E. coli* O157:H7 in food. They are:

- Cook all ground beef thoroughly. Ground beef should be cooked until the thickest part of the patty reaches at least 160F. Temperature is best measured with an instant-read meat thermometer. After cooking, the juices should be clear. Avoid eating ground beef patties that are still pink in the middle.
- Consume only pasteurized dairy and fruit juice products. Avoid raw milk and unpasteurized fruit juices.
- Wash fruits and vegetables thoroughly - especially those that will be eaten without cooking.
- Take measures to avoid cross-contamination during food preparation and service. Wash counters, cutting boards and utensils with hot soapy water after they touch raw meat.
- Be sure to wash your hands prior to preparing, serving, and eating foods.
- Drink municipal water that has been treated with chlorine or other effective disinfectants.
- Avoid swallowing lake or pool water while swimming.

For additional food safety information about meat, poultry, or eggs, call the toll-free USDA Meat and Poultry Hotline at (800) 535-4555. For food safety information about seafood, dairy products, fruits, and vegetables, call the toll-free FDA Outreach and Information Center at (888) SAFEFOOD.