

E. COLI O157:H7, SPINACH, & CATTLE

Ten years ago to the month I wrote about the *E. coli* O157:H7 outbreak in humans caused by unpasteurized apple juice originating in California. That *E. coli* outbreak was caused by deer feces in the apple orchard, the subsequent contamination of the apples, and the failure to pasteurize the product. This month I am again writing about *E. coli* O157:H7 infections in people, this time caused by contaminated spinach. This outbreak of *E. coli* O157:H7 in spinach sickened many consumers in the United States. Many questions come up during these outbreaks and we will attempt to answer some of those in this column.

Why is *E. coli* O157:H7 important? These bacteria (and several other related bacteria) can cause serious illness in humans. There are a number of syndromes that are known to be caused by *E. coli* O157:H7, the first is simply very mild to moderate diarrhea, another is hemorrhagic colitis, in which the patients suffer painful (cramps) and bloody diarrhea. A third is hemolytic uremic syndrome (HUS), in which there is red blood cell destruction, kidney failure, and neurologic complications such as strokes or seizures. Yet another problem in humans is called thrombotic thrombocytopenic purpura (TTP) which is similar to HUS and also causes bleeding disorders. The young, old and immunocompromised (cancer patients on chemotherapy) are at greatest risk to disease due to *E. coli* O157:H7. Illness typically occurs 3 to 4 days following ingestion of contaminated material. Bloody diarrhea can be seen on the second or third day of illness and usually resolves in about a week. Antibiotics have not been shown to help and some antidiarrheal drugs can make the illness worse. Approximately 10% of the people with bloody diarrhea may develop HUS or TTP and some (0.2%) of these patients may die without appropriate treatment. About 150 people were hospitalized in the outbreak due to spinach and there were 3 deaths at last count—so the numbers were typical to what has been observed previously. It is thought that many people become infected and do not develop any illness or symptoms of disease. These asymptomatic, infected people and those with illness (diarrhea) can transmit the *E. coli* O157:H7 to other humans. Another important facet of this disease is the low number of organisms needed to cause infection, estimated at less than 50 organisms. This is contrasted to the several hundred thousand to one million bacteria needed to transmit *Salmonella* infections.

Does *E. coli* O157:H7 cause disease in animals? No concrete evidence has been published demonstrating disease in animals caused by these bacteria. Considerable work has been done in cattle and there is no evidence to date that *E. coli* O157:H7 causes disease in normal cattle operations.

How do humans become infected? Outbreaks of *E. coli* O157:H7 infections are often associated with contaminated foods, while the source of infection in the sporadic cases (individual cases) is not usually identified. Person to person spread also occurs and

is particularly important in day care centers or schools where young children congregate. Some of the common foods thought to be involved with outbreaks include: uncooked (undercooked) beef products, deer jerky, spinach, lettuce, apple cider or apple juice, mayonnaise, cantaloupe, raw milk, and potatoes. Additionally, drinking water and swimming associated outbreaks have been reported. The total number of cases in the U. S. is estimated to be about several thousand although the numbers have been decreasing in recent years. The outbreaks caused by this organism are often food associated; however, many of the cases are sporadic and a source is usually not determined.

What role do cattle play in this disease? Cattle have been studied extensively in regard to this condition, partly because of the large outbreaks involving undercooked hamburgers in the Northwestern U. S. in the 1980's and partly because they are easy to study. The number of healthy cattle with *E. coli* O157:H7 in their feces ranges from 0.33 to 50% or more in the surveys that have been reported. As the technology of identifying this organism has become more sophisticated the easier it has become to find carrier animals. Cattle that shed the *E. coli* O157:H7 organism in their feces may only do so for a short period of time, perhaps only one day. This is in contrast to infected children which can shed the organism for an average of 13-17 days after illness. Cattle feces that contain *E. coli* O157:H7 could possibly contaminate food and this food could be a source of infection. This could occur in processing facilities such as happened in one instance of contaminated hamburger involved in a multi-state outbreak. This organism survives cold temperatures and is able to remain viable in foods such as apple cider and mayonnaise, and thus foods can remain infected for long periods of time. Because cattle have been shown to shed these organisms they have been incriminated as the only source of the problem. From the outbreaks involving houseflies, deer jerky, lettuce, cantaloupes, apple juice, and other foods, it is obvious that cattle are not the sole source of the problem.

What was done to stop the outbreaks due to ground beef? The *E. coli* O157:H7 organism is easily killed by heat. Cooking at 155°F for 0.13 minutes will kill the number of organisms usually present in contaminated ground beef. A law in California (and most other states) was passed that all ground beef must be cooked to 160°F. This method was easy to accomplish for meat products such as hamburger or sausage. Additionally, restaurants adopted this standard as their standard operating procedure (SOP). By the way, this is still the law and if a restaurant worker asks if you want a rare hamburger, that person and premise is not adhering to the law.

What else did beef producers do? First they adopted a zero tolerance attitude for this organism in their product. Then they realized they couldn't get rid of this organism **entirely** in nature or in their cattle. So they invested hundreds of millions of dollars in research and development of technology to rid their finished product of this organism. They have set up multiple hurdles, many steps that kill any *E. coli* O157:H7 that might get onto the meat. In addition, they set up monitoring systems to test each batch of trim that goes into ground beef as an inspection step and to verify the processes and procedures used to kill the *E. coli* are working. The beef processing industry identified critical control points (choke points) where the organism could be killed or

reduced in number. This sort of system is called a HACCP system—Hazard Analysis Critical Control Points.

What do these processes and procedures look like? A typical system will have the following steps:

Clean the animal before it enters the processing plant (clean manure off of the skin and hair).

Chemically de-hair or sanitize the hide after the animal has been killed.

After the hide has been removed, the carcass is washed with an organic acid, usually 2—5.5% lactic acid solutions.

Then the carcass is placed in a steam cabinet.

This is followed by a tri-sodium phosphate wash and it goes to the chill box.

After chilling, the carcass is again washed with a solution to kill any organism.

Trim from the processing floor is accumulated in bins which will be used for ground beef. At least 60 samples are taken from each of these bins and they are tested for *E. coli* O157:H7 in particular. All cultures must be negative. If a positive occurs, the material is removed from the human food chain and all processes and procedures are immediately reevaluated. It should be noted that all procedures used in processing beef have been scientifically shown to be safe and effective for killing the organism, for the workers handling the materials, and for the consumer.

The strict controls used to eliminate *E. coli* O157:H7 in ground beef have an additional benefit. Once processes and procedures are in place to control this organism the *Salmonella* species, *Listeria* species and other pathogens are also controlled. Foods such as milk, apple cider, and apple juice should obviously be pasteurized—this is not only important for preventing infection by *E. coli* O157:H7, but also for *Salmonella*, *Campylobacter*, and other pathogens.

What is the future of this issue? There is much yet to learn about this organism, where it resides in nature, how it makes its way into the various food products, and how we can prevent the *E. coli* O157:H7 diseases in humans. However, it is obvious we cannot eliminate this organism and other related organism from the environment and from several of our food products such as spinach coming from the field. It is also important to understand the great strides the beef producers have made in eliminating this organism from their products. I am sure the beef producers and processors would be happy to share their experience and expertise with other commodities to help them control and eliminate this serious pathogen from their products. It is also important to realize that we have many new tools available in biology and medicine that can possibly

be useful in continuing to make the American food supply the safest and least expensive in the world.

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