BBB - Escherichia coli O157:H7 (EHEC)

Bad Bug Book:
Foodborne Pathogenic Microorganisms and Natural Toxins Handbook

*Escherichia coli* O157:H7

1. Name of the Organism:

*Escherichia coli* O157:H7
(enterohemorrhagic *E. coli* or EHEC)

Currently, there are four recognized classes of enterovirulent *E. coli* (collectively referred to as the EEC group) that cause gastroenteritis in humans. Among these is the enterohemorrhagic (EHEC) strain designated *E. coli* O157:H7. *E. coli* is a normal inhabitant of the intestines of all animals, including humans. When aerobic culture methods are used, *E. coli* is the dominant species found in feces. Normally *E. coli* serves a useful function in the body by suppressing the growth of harmful bacterial species and by synthesizing appreciable amounts of vitamins. A minority of *E. coli* strains are capable of causing human illness by several different mechanisms. *E. coli* serotype O157:H7 is a rare variety of *E. coli* that produces large quantities of one or more related, potent toxins that cause severe damage to the lining of the intestine. These toxins [verotoxin (VT), shiga-like toxin] are closely related or identical to the toxin produced by *Shigella dysenteriae*.

2. Nature of Acute Disease:

Hemorrhagic colitis is the name of the acute disease caused by *E. coli* O157:H7.
3. Nature of Disease:

The illness is characterized by severe cramping (abdominal pain) and diarrhea which is initially watery but becomes grossly bloody. Occasionally vomiting occurs. Fever is either low-grade or absent. The illness is usually self-limited and lasts for an average of 8 days. Some individuals exhibit watery diarrhea only. Infective dose -- Unknown, but from a compilation of outbreak data, including the organism's ability to be passed person-to-person in the day-care setting and nursing homes, the dose may be similar to that of *Shigella* spp. (as few as 10 organisms).

4. Diagnosis of Human Illness:

**CDC Case Definition**

Hemorrhagic colitis is diagnosed by isolation of *E. coli* of serotype O157:H7 or other verotoxin-producing *E. coli* from diarrheal stools. Alternatively, the stools can be tested directly for the presence of verotoxin. Confirmation can be obtained by isolation of *E. coli* of the same serotype from the incriminated food.

5. Associated Foods:

Undercooked or raw hamburger (ground beef) has been implicated in many of the documented outbreaks, however *E. coli* O157:H7 outbreaks have implicated alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, game meat, and cheese curds. Raw milk was the vehicle in a school outbreak in Canada.

6. Relative Frequency of Disease:

Hemorrhagic colitis infections are not too common, but this is probably not reflective of the true frequency. In the Pacific Northwest, *E. coli* O157:H7 is thought to be second only to Salmonella as a cause of bacterial diarrhea. Because of the unmistakable symptoms of profuse, visible blood in severe cases,
those victims probably seek medical attention, but less severe cases are probably more numerous.

7. Course of Disease and Complications:

Some victims, particularly the very young, have developed the hemolytic uremic syndrome (HUS), characterized by renal failure and hemolytic anemia. From 0 to 15% of hemorrhagic colitis victims may develop HUS. The disease can lead to permanent loss of kidney function.

In the elderly, HUS, plus two other symptoms, fever and neurologic symptoms, constitutes thrombotic thrombocytopenic purpura (TTP). This illness can have a mortality rate in the elderly as high as 50%.

8. Target Populations:

All people are believed to be susceptible to hemorrhagic colitis, but young children and the elderly appear to progress to more serious symptoms more frequently.

9. Food Analysis:

FDA's Bacteriological Analytical Manual *Escherichia coli*

Several microbiological methods can be used to isolate *E. coli* O157:H7 from foods. Unlike typical *E. coli*, isolates of O157:H7 do not ferment sorbitol and are negative with the MUG assay; therefore, these criteria are commonly used for selective isolation. Sorbitol-MacConkey agar has been used extensively to isolate this organism from clinical specimens. Hemorrhagic colitis agar, a selective and differential medium, is used in a direct plating method to isolate O157:H7 from foods. A third procedure uses Sorbitol-MacConkey medium containing potassium tellurite and Cefixime. It includes an enrichment step and is a new method developed as result of the recent foodborne outbreaks. Rapid
methods using a variety of technologies, including recombinant DNA methods, are being developed.

10. Selected Outbreaks:

For more information on recent outbreaks see the Morbidity and Mortality Weekly Reports from CDC.

11. Education and Background Resources:

Literature references can be found at the links below.
Loci index for genome Escherichia coli O157:H7
Available from the GenBank Taxonomy database, which contains the names of all organisms that are represented in the genetic databases with at least one nucleotide or protein sequence.
USDA (Aug 11 1998)
USDA Urges Consumers To Use Food Thermometer When Cooking Ground Beef Patties
Preventing Escherichia coli O157:H7 infections
A CDC information brochure.
In the past decade, outbreaks of human illness associated with the consumption of raw vegetables and fruits (or unpasteurized products produced from them) have increased in the United States. Pathogens such as Listeria monocytogenes, Clostridium botulinum, and Bacillus cereus are naturally present in some soil, and their presence on fresh produce is not rare. Salmonella, Escherichia coli O157:H7, Campylobacter jejuni, Vibrio cholerae, parasites, and viruses are more likely to contaminate fresh produce through vehicles such as raw or improperly composted manure, irrigation water containing untreated sewage, or contaminated wash water. Treatment of produce with chlorinated water reduces populations of pathogenic and other microorganisms on fresh produce but cannot
eliminate them. Reduction of risk for human illness associated with raw produce can be better achieved through controlling points of potential contamination in the field; during harvesting; during processing or distribution; or in retail markets, food-service facilities, or the home.

CDC *Escherichia coli O157:H7 FAQ's*

Frequently Asked Questions about *Escherichia coli O157:H7.*

*Emerging Infectious Diseases (1995) 1(2)*

A monograph on *E. coli* O157:H7, written Dr. Feng of FDA/CFSAN

USDA's *E. coli O157:H7 risk assessment*

The overall goal of this risk assessment is to assess the likelihood of human morbidity and mortality associated with *E. coli* O157:H7 in ground beef in the United States. The risk assessment identifies the occurrence and concentration of this pathogen at specific points from farm-to-table and will assist FSIS in reviewing and refining its risk reduction strategy for *E. coli* O157:H7 in ground beef. In addition, the risk assessment will identify future research needs.