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Preventing Foodborne Illness: *E. coli* O157:H7¹

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This is one in a series of fact sheets discussing common foodborne pathogens of interest to food handlers, processors, and retailers.

What causes a foodborne illness?

Escherichia coli or *E. coli* is a bacterium from the family *Enterobacteriaceae* that is usually found in the digestive system of healthy humans and animals, and is transmitted through fecal contamination. There are hundreds of known *E. coli* strains, with *E. coli* O157:H7 being the most dangerous. This enterohemorrhagic strain is responsible for an estimated 73,000 cases of infection and 61 deaths in the United States annually. *E. coli*, in general, are found everywhere in the environment, but mostly occupy animal surfaces and digestive systems. This makes it important to thoroughly wash anything that comes into contact with these surfaces.

What is *E. coli* O157:H7?

E. coli O157:H7 are gram-negative rods that have been variously described as verotoxigenic *E. coli* (VTEC) or shiga-like toxin producing *E. coli* (SLTEC). Most recently, the designation has been simplified to shiga-toxin producing *E. coli* (STEC) in

recognition of the similarities of the toxins produced by *E. coli* O157:H7 and *Shigella dysenteriae*. These potent toxins are the cause of severe damage to the intestinal tract lining of those infected. The presence of *E. coli* O157:H7 toxins is responsible for the symptoms associated with infection: hemorrhagic colitis, hemolytic uremic syndrome (HUS), and even death. The organism can survive at low temperatures and under acidic conditions making it difficult to eradicate in nature.

What are the symptoms associated with *E. coli* O157:H7?

The acute disease associated with this organism is named hemorrhagic colitis. The symptoms characteristic to this disease are watery and/or bloody diarrhea, fever, nausea, severe abdominal cramping, and vomiting. Because most people recover from this infection on their own, treatment is usually not necessary. Symptoms can appear within hours or up to several days after ingestion of the bacteria (10-100 cells) and the illness duration is normally 5-10 days.

Some individuals may develop hemolytic uremic syndrome (HUS). In the very young, this disorder

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can cause renal failure, hemolytic anemia, or even permanent loss of kidney function. In the elderly, these symptoms as well as thrombotic thrombocytopenic purpura (HUS with additional neurological dysfunction and/or fever) may occur.

Who is at Risk?

E. coli O157:H7 infects everyone, but is more prone to attacking the very young (under 5 years) and the very old. This infection is also associated with immuno-compromised patients. Those working in slaughterhouses, farms, hospitals, nursing homes, nursery schools, and food preparation locations are more susceptible to infections than the rest of the population.

What foods have been commonly associated with *E. coli* O157:H7?

The most common sources of *E. coli* O157:H7 infections are undercooked or raw hamburgers, sheep, pigs, goats, poultry, game meat, alfalfa sprouts, unpasteurized fruit juices, dry-cured salami, lettuce, cheese curds, unpasteurized or raw milk, contaminated water and ice, and person-to-person transmission. Fruits and vegetables also cause infection due to contact with contaminated water. However, infection is mostly caused by consumption of undercooked or raw meats. There appears to be a very low infective dose for this organism (10–100 cells), making adequate sanitation and/or proper processing of foods critically important.

What sanitation methods are used to prevent infection?

The suggestions below are good examples of how to improve and prevent infections (www.fmi.org):

In the home,

- Never thaw food on the counter or let it sit out of the refrigerator over two hours.
- Use refrigerated ground meat in 3-4 days; frozen meat in 3-4 months.

- Cook meat until the center is gray or brown. Cook to an internal temperature of 160°F (71°C). This should be determined using a meat thermometer that is calibrated regularly.
- Serve cooked food with clean plates and utensils.
- Never allow raw foods to contact ready-to-eat foods, utensils and dishes.
- Drink only pasteurized milk, milk products, and fruit juices.
- Thoroughly wash fruits and vegetables with clean water.
- Follow rules of personal hygiene, especially after bathroom use and the handling of diapers.
- Make sure drinking water has been properly treated.

On the farm,

- Use potable quality water for washing fruits and vegetables.
 - Manage fecal waste in a way that fresh water will not become contaminated.
- In meat processing facilities,
- Assure GMPs are being used in slaughterhouses and processing units.
 - Apply approved treatments of carcasses to remove fecal bacteria.

Because illness is associated with *E. coli* O157:H7, hand washing must be carefully executed and thorough. It is important to wash hands before, during and after: handling raw foods, smoking, cleaning, using the restroom, and touching soiled equipment or clothing. The following is the proper technique for hand washing:

- Wet your hands with warm water.
- Apply soap and wash your hands for 20 seconds.
- Rinse and dry with a single-use paper towel.

- Use the paper towel to shut off the water.

Good Practices for Food Product Receiving, Handling, Processing and Storage

The FDA defines Current Good Manufacturing Practices for food (cGMPs) in 21 CFR, Part 110. These cGMPs outline minimally required general sanitation requirements in FDA inspected food handling and processing facilities. It is recommended that more specific and stringent standard operating procedures (SOPs) be developed for individual facilities. In addition, the sanitation recommendations for food service and retail food facilities outlined in the FDA Food Code (FDA, 1999 and 2001) have been adopted into many state and local regulations. As there may be some variation in Food Code adoption, it is important that each facility check with the appropriate state and/or local regulatory authority. The Florida statutes can be found at <http://www.flsenate.gov/statutes/>, Title 33: Chapter 509.

In addition to setting and adhering to strict sanitation requirements in the facility, a retail establishment should also develop SOPs for receiving and storage of food products and ingredients. If food processing is being done, appropriate controls and requirements should be established and strictly adhered to. FDA Food Code outlines appropriate processing and cooking requirements for many food products processed in a retail facility. However, if certain high-risk food products (such as sushi, fresh juice, specialty meats and others) are processed in the retail establishment, rather than in a more traditional processing facility, additional controls and the issuance of a variance by the regulatory authority is required before processing can occur (Food Code 3-502.11). The growing retail practice of cooking/preparing/ packaging foods traditionally processed in controlled plant environments raises safety concerns. Any processing of food at the retail level needs to be closely monitored.

As an establishment becomes cleaner, it becomes harder to detect foodborne pathogens. At this point testing becomes more limited in its ability to prevent foodborne illness. This is why programs

that promote and monitor the use of barriers and/or hurdles are so important. When instituted properly these activities will reduce the risk of a foodborne illness. Nothing can be done to completely eliminate bacterial contamination short of vacuum sealing, irradiating and storing all your products frozen. Since most consumers prefer a fresh product, programs should be implemented that reduce the probability of illness to a point that it is minuscule.

Receiving

Specifications for receiving can be found in section 3-202.11 of the 2001 Food Code <http://www.cfsan.fda.gov/~dms/foodcode.html>. The following guidelines cover the basic points that should be addressed:

- Potentially Hazardous Food (PHF) should be at a temperature of 5°C or below when received, unless specified by law (e.g., milk, shellfish).
- Raw shell eggs should be received at an ambient air temperature of 7°C or less.
- PHFs that are received hot should be at a temperature of 60°C or above.
- PHF should be received with no evidence of temperature abuse such as evidence of thawing.

Processing

One of the easiest ways to prevent foodborne illness associated with *E. coli* O157:H7 is ensuring that foods are cooked thoroughly. It should be noted that certain foods that are typically served uncooked such as raw eggs (used in Caesar salads, homemade mayonnaise, raw cookie dough, etc.) and fresh vegetables will obviously not benefit from the cooking process. For these items, other factors such as sanitation, worker hygiene and proper storage take on much greater importance.

- When using raw eggs in your recipes, try to purchase a pasteurized egg product.
- Cook eggs, fish, meat, or foods containing these items to an internal temperature of 145°F or above for a minimum of 15 seconds (2001 Food Code).

- Cook ground meat products to an internal temperature of 155°F or above for a minimum of 15 seconds (2001 Food Code).
- Cook poultry to an internal temperature of 165°F or above for a minimum of 15 seconds (2001 Food Code).
- Reheating previously cooked material to an internal temperature to 165°F.

For recommendations that are more specific consult the 1999 or 2001 Food Code
<http://www.cfsan.fda.gov/~dms/foodcode.html>.

Storage

Once a product has been received and/or processed, it now will be displayed or stored. There are some general guidelines governing these practices as well.

- Frozen food should remain frozen until it is used.
- If frozen food is displayed in a refrigerated case and allowed to thaw, the food should remain at 5°C or below.
- Frozen food should be thawed at a temperature of 5°C or below or under running water at a temperature of 21°C or below.
- Lastly, the product can be thawed as part of the cooking process.
- Product must be cooled adequately. Refer to sections 3-501.14 and 3-501.15 of the 1999 or 2001 Food Code
<http://www.cfsan.fda.gov/~dms/foodcode.html>
- Cooked product should be maintained above 60°C while displayed and stored at or under 5°C.
- Properly label all stored product.

Personal Hygiene

Wash your hands! The major cause of foodborne illness in retail establishment comes from poor personal hygiene, particularly a lack of proper hand

washing. Dirty hands can contaminate food. Although hands may look clean, the bacteria that cause illness are too small to be seen. Therefore, whenever you are preparing food and you come in contact with items that are not part of the assembly process, rewash your hands. The same is true even when wearing gloves. **THERE IS NO FIVE SECOND RULE WHEN IT COMES TO FOOD SAFETY!** Millions of bacteria and other germs can be transferred on contact. Here is a list of times when should you wash your hands:

- Before handling, preparing food or serving food.
- Before handling clean utensils or dishware.
- After using the restroom.
- After touching your face, cuts or sores.
- After smoking/eating/drinking.
- After handling raw meat - especially poultry.
- After touching unclean equipment, working surfaces, soiled clothing, soiled wiping cloths, etc.
- After collecting and taking out the garbage.

What is the Proper Procedure for Hand Washing?

- Wet your hands with warm water.
- Apply soap and wash your hands for 20 seconds.
- Rinse and dry with a single-use paper towel.
- Use the paper towel to shut off the water.

Resources:

fmi@fmi.org. Food Marketing Institute. Food Safety & Security; *Escherichia coli*. (2001)

<http://vm.cfsan.fda.gov/~mow/chap15.html>

http://www.cdc.gov/ncidod/dbmd/diseaseinfo/escherichiacoli_g.htm

<http://people.ku.edu/%7Ejbrown/ecoli.html>

<http://www.nfid.org/factsheets/ecoli.html>

<http://www3.bc.sympatico.ca/me/patientsguide/eo157.htm>