

Bacterial Foodborne Illness

Fact Sheet No. 9.300

Food and Nutrition Series | Health

by P. Kendall*

Bacterial foodborne infections occur when food, that is contaminated with bacteria, is eaten and the bacteria continues to grow in the intestines, setting up an infection which causes illness. *Salmonella*, *Campylobacter*, hemorrhagic *E. coli* and *Listeria* all cause infections.

Food intoxication results from consumption of toxins (or poisons) produced in food by bacterial growth. Toxins, not bacteria, cause illness. Toxins may not alter the appearance, odor or flavor of food. Common kinds of bacteria that produce toxins include *Staphylococcus aureus* and *Clostridium botulinum*. (See fact sheet 9.305, *Botulism*, for more information on its prevention.) In the case of *Clostridium perfringens*, illness is caused by toxins released in the gut when large numbers of vegetative cells are eaten.

Salmonellosis

Salmonellosis is a form of food infection that may result when foods containing *Salmonella* bacteria are consumed. The *Salmonella* family includes more than 2300 serotypes, but two types, *Salmonella enteritidis* and *Salmonella typhimurium* are the most common in the United States and account for half of the infections.

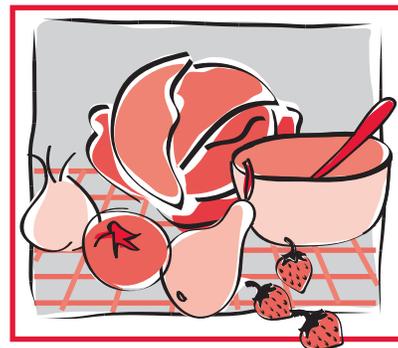
Once eaten, the bacteria may continue to live and grow in the intestine, set up an infection and cause illness. The possibility and severity of the illness depends in large part on the size of the dose, the resistance of the host and the specific strain of *Salmonella* causing the illness.

Salmonella bacteria are spread through indirect or direct contact with the intestinal contents or excrement of animals, including humans. For example, they may be spread to food by hands that are not washed after using the toilet. They also may be spread to raw meat during processing so that it is contaminated when brought into the kitchen. Because of this, it is important to make sure hands and working surfaces are thoroughly washed after contact with raw meat, fish and poultry and before working with foods that require no further cooking.

Salmonella bacteria grow at temperatures between 41 and 113 degrees F. They are readily destroyed by cooking to 160 F and do not grow at refrigerator or freezer temperatures. They do survive refrigeration and freezing, however, and will begin to grow again once warmed to room temperature.

Symptoms of salmonellosis include headache, diarrhea, abdominal pain, nausea, chills, fever and vomiting. These occur within 8 to 72 hours after eating contaminated food and may last four to seven days. Arthritis symptoms may follow three to four weeks after onset of acute symptoms. Infants, young children, pregnant women, the elderly or people already ill have the least resistance to disease effects.

Foods commonly involved include eggs or any egg-based food, salads (such as tuna, chicken, or potato), poultry, beef, pork, processed meats, meat pies, fish, cream desserts and fillings, sandwich fillings, raw sprouts, and milk products. These foods may be contaminated at any of the many points where the food is handled or processed from the time of slaughter or harvest until it is eaten.



Quick Facts

- *Salmonella*, *Campylobacter*, *E. coli* and *Listeria* bacteria in food cause food infection.
- *Staphylococcus* and *Clostridium botulinum* bacteria produce a toxin (or poison) as a by-product of growth and multiplication in food and cause food intoxication.
- *Clostridium perfringens* can multiply in foods to sufficient numbers to cause food poisoning.
- By following simple steps (clean, separate, cook, and chill) you can prevent most food-related illness. And, when in doubt, throw it out!

© Colorado State University Extension. 8/98. Revised 7/12.

www.ext.colostate.edu



*P. Kendall, Ph.D., R.D., Colorado State University, associate dean of research, food science and human nutrition. 7/2012

Campylobacteriosis

Campylobacteriosis or *Campylobacter* enteritis is caused by consuming food or water contaminated with the bacteria *Campylobacter jejuni*. *C. jejuni* commonly is found in the intestinal tracts of healthy animals (especially chickens) and in untreated surface water. Raw and inadequately cooked foods of animal origin and non-chlorinated water are the most common sources of human infection (e.g., raw milk, undercooked chicken, raw hamburger, raw shellfish). The organism grows best in a reduced oxygen environment, is easily killed by heat (120 F), is inhibited by acid, salt and drying, and will not multiply at temperatures below 85 F.

Diarrhea, nausea, abdominal cramps, muscle pain, headache and fever are common symptoms. Onset usually occurs two to ten days after eating contaminated food. Duration is two to seven days, but can be weeks with such complications as urinary tract infections and reactive arthritis. Meningitis, recurrent colitis, acute cholecystitis, and Guillain-Barre syndrome are rare complications. Deaths, also rare, have been reported.

Preventive measures for *Campylobacter* infections include pasteurizing milk; avoiding post-pasteurization contamination; cooking raw meat, poultry and fish; and preventing cross-contamination between raw and cooked or ready-to-eat foods.

Listeriosis

Prior to the 1980s, listeriosis, the disease caused by *Listeria monocytogenes*, was primarily of veterinary concern, where it was associated with abortions and encephalitis in sheep and cattle. As a result of its wide distribution in the environment, its ability to survive for long periods under adverse conditions, and its ability to grow at refrigeration temperatures, *Listeria* has since become recognized as an important foodborne pathogen. *L. monocytogenes* is frequently carried by humans and animals. The organism can grow in the pH range of 4.4 to 9.6. It is salt tolerant

and relatively resistant to drying, but easily destroyed by heat. (It grows between 32 F and 113 F).

Listeriosis primarily affects newborn infants, pregnant women, the elderly and those with compromised immune systems. In a healthy non-pregnant person, listeriosis may occur as a mild illness with fever, headaches, nausea and vomiting. Among pregnant women, intrauterine or cervical infections may result in spontaneous abortion or still birth. Infants born alive may develop meningitis. The mortality rate in diagnosed cases is 20 to 25 percent. The incubation period is a few days to several weeks. Recent cases have involved raw milk, soft cheeses made with raw milk, and raw or refrigerated ready-to-eat meat, poultry or fish products. In 2011, a large outbreak of listeriosis was caused by cantaloupe contaminated during processing at one facility.

Preventive measures for listeriosis include maintaining good sanitation, turning over refrigerated ready-to-eat foods quickly, pasteurizing milk, avoiding post-pasteurization contamination, and cooking foods thoroughly.

Staphylococcal Intoxication

Staphylococcus bacteria are found on the skin and in the nose and throat of most people; people with colds and sinus infections are often carriers. Infected wounds, pimples, boils and acne are generally rich sources. *Staphylococcus* also are widespread in untreated water, raw milk and sewage.

When *Staphylococcus* bacteria get into warm food and multiply, they produce a toxin or poison that causes illness. The toxin is not detectable by taste or smell. While the bacteria itself can be killed by temperatures of 120 F, its toxin is heat resistant; therefore, it is important to keep the staph organism from growing.

Foods commonly involved in staphylococcal intoxication include protein foods such as ham, processed meats, tuna, chicken, sandwich fillings, cream fillings, potato and meat salads, custards, milk products

and creamed potatoes. Foods that are handled frequently during preparation are prime targets for staphylococci contamination.

Symptoms include abdominal cramps, vomiting, severe diarrhea and exhaustion. These usually appear within one to eight hours after eating staph-infected food and last one or two days. The illness seldom is fatal.

Keep food clean to prevent its contamination, keep it either hot (above 140 F) or cold (below 40 F) during serving time, and as quickly as possible refrigerate or freeze leftovers and foods to be served later.

Clostridium Perfringens Foodborne Illness

Clostridium perfringens belong to the same genus as the botulinum organism. However, the disease produced by *C. perfringens* is not as severe as botulism and few deaths have occurred. Spores are found in soil, nonpotable water, unprocessed foods and the intestinal tract of animals and humans. Meat and poultry are frequently contaminated with these spores from one or more sources during processing.

Spores of some strains are so heat resistant that they survive boiling for four or more hours. Furthermore, cooking drives off oxygen, kills competitive organisms and heat-shocks the spores, all of which promote germination.

Once the spores have germinated, a warm, moist, protein-rich environment with little or no oxygen is necessary for growth. If such conditions exist (i.e., holding meats at warm room temperature for several hours or cooling large pots of gravy or meat too slowly in the refrigerator), sufficient numbers of vegetative cells may be produced to cause illness. Foods commonly involved in *C. perfringens* illness include cooked, cooled, or reheated meats, poultry, stews, meat pies, casseroles, and gravies.

Symptoms occur within eight to 24 hours after contaminated food is eaten. They include acute abdominal pain and diarrhea. Nausea, vomiting and fever

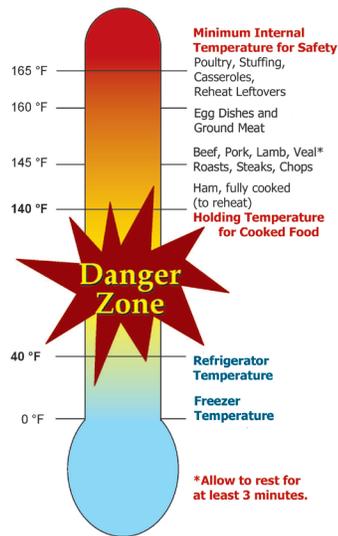


Figure 1: Temperature of food for control of bacteria.

are less common. Recovery usually is within one to two days, but symptoms may persist for one or two weeks.

***E. coli* Hemorrhagic Colitis**

Escherichia coli belong to a family of microorganisms called coliforms. Many strains of *E. coli* live peacefully in the gut, helping keep the growth of more harmful microorganisms in check. However, one strain, *E. coli* O157:H7, causes a distinctive and sometimes deadly disease.

Symptoms begin with nonbloody diarrhea one to five days after eating contaminated food, and progress to bloody diarrhea, severe abdominal pain and moderate dehydration. In young children, hemolytic uremic syndrome (HUS) is a serious complication that can lead to renal failure and death. In adults, the complications sometimes lead to thrombocytopenic purpura (TPP), characterized by cerebral nervous system deterioration, seizures and strokes.

Ground beef is the food most associated with *E. coli* O157:H7 outbreaks, but other foods also have been implicated. These include raw milk, unpasteurized apple juice and cider, dry-cured salami, homemade venison jerky, sprouts, lettuce, spinach, and untreated water. Infected food handlers and diapered infants with the disease likely help spread the bacteria.

Preventive strategies for *E. coli* infections include thorough washing and other measures to reduce the presence of the microorganism on raw food, thorough cooking of raw animal products, and avoiding recontamination of cooked meat with raw meat. To be safe, cook ground meats to 160 F.

Preventing Foodborne Illness

Foodborne illness can be prevented. The following food handling practices have been identified by the Food Safety and Inspection Service of USDA as essential in preventing bacterial foodborne illness.

Purchase and Storage

- Keep packages of raw meat and poultry separate from other foods, particularly foods to be eaten without further cooking. Use plastic bags or other packaging to prevent raw juices from dripping on other foods or refrigerator surfaces.
- Buy products labeled “keep refrigerated” only if they are stored in a refrigerated case. Refrigerate promptly.
- Buy dated products before the label sell-by, use-by or pull-by date has expired.
- Use an appliance thermometer to make sure your refrigerator is between 35 and 40 F and your freezer is 0 F or below.

Preparation

- Wash hands (gloved or not) with soap and water for 20 seconds before preparing foods and after handling raw meat or poultry, touching animals, using the bathroom, changing diapers, smoking or blowing your nose.
- Thaw only in refrigerator, under cold water changed every 30 minutes, or in the microwave (followed by immediate cooking).
- Rinse raw produce thoroughly under running tap water before eating.

- Scrub containers and utensils used in handling uncooked foods with hot, soapy water before using with ready-to-serve foods. Use separate cutting boards to help prevent contamination between raw and cooked foods.
- Stuff raw products immediately before cooking, never the night before.
- Don't taste raw meat, poultry, eggs, fish or shellfish. Use pasteurized milk and milk products.
- Do not eat raw eggs. This includes milk shakes with raw eggs, Caesar salad, Hollandaise sauce, and other foods like homemade mayonnaise, ice cream or eggnog made from recipes that call for uncooked eggs.
- Use a meat thermometer to judge safe internal temperatures for cooked foods (see Figure 1). If your microwave has a temperature probe, use it.
- When using slow cookers or smokers, start with fresh rather than frozen, chunks rather than roasts or large cuts, and recipes that include a liquid. Check internal temperature in three spots to be sure food is thoroughly cooked.
- Avoid interrupted cooking. Never partially cook products, to refrigerate and finish later. Also, don't put food in the oven with a timer set to begin cooking later in the day.
- If microwave cooking instructions on the product label are not appropriate for your microwave, increase microwave time to reach a safe internal temperature. Rotate, stir and/or cover foods to promote even cooking.
- Before tasting, boil all home-canned vegetables and meats 10 minutes plus one minute per 1,000 feet.

Serving

- Wash hands with soap and water before preparing, serving, or eating food. Serve cooked products on clean plates with clean utensils and clean hands.

- Keep hot foods hot (above 140 F) and cold foods cold (below 40 F).
- In environmental temperatures of 90 F or warmer, leave cooked food out no longer than one hour before reheating, refrigerating or freezing. At temperatures below 90 F, leave out no more than two hours.
- If in doubt, throw it out. So they cannot be eaten by people or animals, discard outdated, unsafe or possibly unsafe leftovers in the garbage disposal or in tightly-wrapped packages.

Handling Leftovers

- Wash hands before handling leftovers and use clean utensils and surfaces.
- Remove stuffing before cooling or freezing.
- Refrigerate or freeze cooked leftovers in small, covered shallow containers (2 inches deep or less) within two hours after cooking. Leave airspace around containers to help ensure rapid, even cooling.
- Use cooked leftovers within 4 days. Don't taste leftovers to determine safety.
- If reheating leftovers, cover and reheat to appropriate temperature before serving (a rolling boil for sauces, soups, gravies, "wet" foods; 165 F for all others).

References

- Jay, J.M. *Modern Food Microbiology*. Gaithersburg, MD: Aspen Publishers, 2005.
- Center for Food Safety and Applied Nutrition of the Food and Drug Administration (FDA), U.S. Department of Health and Human Services. 2012. *Bad Bug Book – Foodborne Pathogenic Microorganisms and Natural Toxins Handbook*, 2nd Ed. Available at: <http://www.fda.gov>.
- U.S. Department of Agriculture Food Safety and Inspection Service. 2011. *Basics for Handling Food Safely*. Available at: www.fsis.usda.gov/PDF/Basics_for_Safe_Food_Handling.pdf.