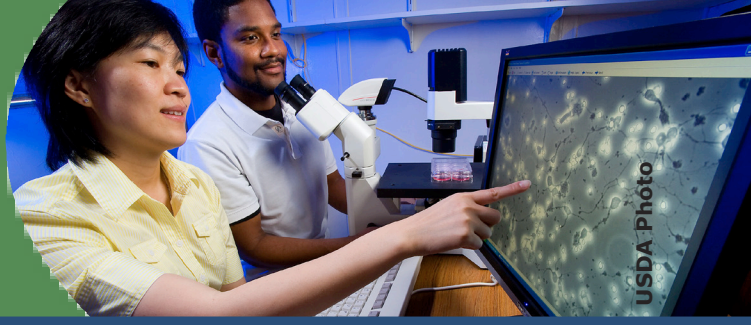
United States Department of Agriculture
Food Safety and Inspection Service

Food Safety Information



Clostridium botulinum

What is *Clostridium botulinum*?

Clostridium botulinum are rod-shaped bacteria (also called *C. botulinum*. They are anaerobic, meaning they live and grow in low oxygen conditions. The bacteria form protective spores when conditions for survival are poor. The spore has a hard protective coating that encases the key parts of the bacterium and has layers of protective membranes. Within these membranes and the hard coating, the dormant bacterium is able to survive for years. *C. botulinum* is responsible for a disease called botulism.

What is Botulism?

Botulism is a life-threatening disease caused by the ingestion of a potent neurotoxin produced during growth of the *C. botulinum* bacteria. This neurotoxin is among the most toxic substances known; even microscopic amounts can cause illness or death. In the past, botulism was linked primarily to home-canned foods. In recent decades, however, botulism illnesses have been linked to foods such as unrefrigerated homemade salsa, baked potatoes sealed in aluminum foil, honey (the primary cause of botulism in infants), garlic in oil, and traditionally prepared salted or fermented fish.

Where is *Clostridium botulinum* Found?

C. botulinum is prevalent in soil and marine sediments worldwide, most commonly as spores. These spores are found everywhere. While the spores are generally harmless, the danger can occur once the spores begin to grow out into active bacteria and produce neurotoxins. A neurotoxin is a poisonous chemical that affects the central nervous system. It can destroy, paralyze, or adversely affect nerves or nerve tissue. *C. botulinum* produces seven different types of neurotoxins designated by the letters A through G; only types A, B, E, and F cause illness in humans.

How is the Toxin Produced in Food?

C. botulinum spores are often found on the surfaces of fruits and vegetables and in seafood. The organism grows best under low-oxygen conditions and produces spores and toxins. The toxin is most commonly formed when food is improperly processed (canned) at home. *C. botulinum* cannot grow below a pH of 4.6, so acidic foods, such as most fruits, tomatoes, and pickles, can be safely processed in a water bath canner. However, foods with a higher pH (most vegetables and meats) must be processed under pressure. Therefore, a pressure cooker should be used. The pressure cooker will reach high-enough temperatures to destroy the *C. botulinum* spores.

For example, if a low-acid food, such as green beans, is canned improperly (not canned under pressure or improperly canned using a pressure canner), *C. botulinum* bacteria and other bacteria present will be destroyed by the boiling of water and food, but the *C. botulinum* spores will not be destroyed. The canning process will remove the oxygen from the jar, creating a low-oxygen environment that will allow the spores to grow into active bacteria. When the jars are stored at room temperature, the spores can germinate and produce the toxin. However, the toxin is sensitive to heat and can be destroyed if the food in question is boiled for 10 minutes (longer at high altitudes).

USDA Meat & Poultry Hotline
1-888-MPHotline
(888-674-6854)

The Disease

Botulism is a paralyzing disease affecting the body's nervous system that is caused by the ingestion of one of the potent neurotoxins produced by *C. botulinum* bacterium. This neurotoxin is among the most toxic substances known; even microscopic amounts can cause illness.

What are the Symptoms?

Symptoms of botulism usually appear within 12 to 36 hours after eating food containing the neurotoxin, although there have been documented cases that ranged from 4 hours to 8 days. The earlier the symptoms appear, the more serious the disease. Treatment requires quick medical attention and an antitoxin.

How Does the Illness Occur?

Once in the body, the toxin binds to nerve endings that join muscles. This prevents the nerves from signaling the muscles to contract. The first symptoms of botulism are nausea, vomiting, weakness, and vertigo (dizziness). These are followed by neurological symptoms: visual impairments (blurred or double vision), loss of normal throat and mouth functions (difficulty speaking and swallowing; dry mouth, throat, and tongue; and sore throat), general fatigue, lack of muscle coordination, and difficulty in breathing. Gastrointestinal symptoms may include abdominal pain, diarrhea, or constipation. Death is usually caused by respiratory failure and airway obstructions. When the diaphragm and chest muscles become fully involved, breathing is affected and results in death from asphyxia.

If botulism is caught in the early stages, the injection of an antitoxin can lessen the severity of the disease by neutralizing any toxin that has not yet bound to nerve endings. However, due to the risk of serious side effects, the antitoxin cannot always be used. A human-derived antitoxin is used to treat cases of infant botulism and is available from the California Department of Public Health.

What is Infant Botulism?

Infant botulism may affect infants under 12 months of age, but most commonly those under 2 months of age. It occurs when infants eat food, such as honey, that contains spores of *C. botulinum* that germinate, colonize, and produce neurotoxin in the infant's intestinal tract. **For this reason, the U.S. Food and Drug Administration, the Centers for Disease Control and Prevention, and the American Academy of Pediatrics recommend that honey not be given to children under 1 year of age. Also, fruits and vegetables should be washed before being fed to infants.**

How Do Nitrates and Nitrites Prevent Botulism?

Nitrites are used in certain cured meat and poultry products to inhibit the growth of the bacterial spores of *C. botulinum*. The U.S. Department of Agriculture (USDA) authorized the use of nitrite in meat and poultry products beginning in 1925.

Nitrate and nitrites are different compounds made from nitrogen and oxygen and are used in curing meats. (For more information on curing, see: http://www.fsis.usda.gov/factsheets/ham/index.asp.) Both sodium nitrate and potassium nitrate, along with nitrites, are used to cure or preserve meats by slowing bacterial growth. They also prevent rancidity.

Concern was raised in the early 1970s over the risk of nitrites reacting with amines in food to create a class of carcinogenic compounds called nitrosamines. Processors may use ascorbic acid (Vitamin C), erythorbic acid, or their salts to accelerate the combination of nitrate with the meat components so there will not be enough nitrite available during cooking to form nitrosamines and to inhibit the formation of nitrosamines during curing. Most nitrites disappear from the cured product as it combines with the meat after it has accomplished its curing effects. After cooking, as little as one-fourth may remain, and over time, the amount further declines.

What is the Best Way to Prevent Botulism?

The control of foodborne botulism is based almost entirely on thermal destruction (heating) of the spores or inhibiting spore germination into bacteria and allowing cells to grow and produce toxins in foods. To prevent foodborne botulism:

- Use approved heat processes for commercially and home-canned foods (i.e., pressure-can low-acid foods such as corn or green beans, meat, or poultry).
- Discard all swollen, gassy, or spoiled canned foods. Double bag the cans or jars with plastic bags that are tightly closed. Then place the bags in a trash receptacle for non-recyclable trash outside the home. Keep it out of the reach of humans and pets.
- **Do not taste or eat foods from containers that are leaking, have bulges or are swollen, look damaged or cracked, or seem abnormal in appearance. Do not use products that spurt liquid or foam when the container is opened.**
- Boil home-processed, low-acid canned foods for 10 minutes prior to serving. For higher altitudes, add 1 minute for each 1,000 feet of elevation.
- Refrigerate all leftovers and cooked foods within 2 hours after cooking (1 hour if the temperature is above 90 °F).
- One of the most common causes of foodborne botulism is improperly home-canned food, especially low-acid foods such as vegetables and meats. Only a pressure cooker/canner allows water to reach 240 to 250 °F, a temperature that can kill the spores.

More Information

Consumers who preserve foods at home should follow the guidelines in the publication *USDA's Complete Guide to Home Canning, 2009 Revision*, at http://www.uga.edu/nchfp/publications/publications_usda.html.

Information is also available from the National Center for Home Food Preservation at http://www.uga.edu/nchfp/index.html.

Food Safety Questions?

Call the USDA Meat & Poultry Hotline

If you have a question about meat, poultry, or egg products, call the USDA Meat and Poultry Hotline toll free at **1-888-MPHotline (1-888-674-6854)** The hotline is open year-round

Monday through Friday from 10 a.m. to 4 p.m. ET (English or Spanish). Recorded food safety messages are available 24 hours a day. Check out the FSIS Web site at **www.fsis.usda.gov**.

Send E-mail questions to **MPHotline.fsis@usda.gov**.

Ask Karen!

FSIS' automated response system can provide food safety information 24/7 and a live chat during Hotline hours.

AskKaren.gov

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Issued January 2010