

Clostridium Botulinum and Foodborne Illness

Karen Penner, Ph.D.
Extension State Leader and Professor

Karen Blakeslee
Graduate Assistant

Department of Foods and Nutrition

What is *C. botulinum*?

Clostridium botulinum is a bacterium that may cause botulism, a severe foodborne illness. Strains of *C. botulinum* can produce eight distinct toxins, five of which are capable of causing disease in humans.

C. botulinum is an anaerobic organism and, therefore, prefers environments like those found in a sealed jar or in a large container of thick food in which the freely available oxygen has been driven off through heating.

Foods often associated with botulism are improperly processed, usually home canned, low-acid foods. Examples are meats, poultry, green beans, asparagus, peppers, corn, beets, spinach, and mushrooms. Other foods are smoked, vacuum packed fish; garlic products packed in oil; grilled onions; baked potatoes; turkey loaf; and stew.

Conditions for growth and toxin production

Garden produce may contain soil-borne *C. botulinum* spores at the time of harvest. These spores are inactive. Spores can become vegetative and produce deadly toxins under the right conditions. These conditions—high moisture, no oxygen, low acidity (pH over 4.6), and room temperature—may be present in improperly canned green beans, corn, peas, or other low-acid products.

Low-acid foods require high temperature processing using a pressure canner if they are to be canned and safe to eat. Pressure canning is necessary to achieve a high enough temperature to destroy spores before they can become vegetative. (Refer to Kansas Cooperative Extension publication *Preserving Vegetables, MF-1181*, for more information on home canning of vegetables).

Conditions favorable for botulism may also occur in uncanned foods. Putting garlic in oil creates anaerobic conditions for the garlic, as does wrapping potatoes in foil. Holding these products at warm kitchen temperatures for long time periods encourages growth of vegetative cells and the production of toxin.

The toxin can enter the body through ingestion, inhalation, or absorption through the eye or a cut in the skin. The botulinum toxins are the most toxic substances known; only a small amount of the toxin is needed to cause illness and death. Animals can also develop botulism from eating the same contaminated food.

How serious is the illness?

Botulism symptoms may develop anywhere between eight hours and eight days after ingesting the toxin, most commonly within twelve to forty-eight hours. Symptoms consist of nausea, vomiting, double vision, fatigue, dizziness, difficulty breathing, and headache; dryness of skin, mouth, and throat; and constipation, lack of fever, and paralysis for one to ten days or more.

The mortality rate varies between 30 and 65 percent. Early detection and treatment is extremely important to avoid death or severe, long-term effects. Because the nervous system is affected, recovery for those who survive can take years.

Infant botulism is another type of botulism. It may occur in infants under fourteen months because their intestinal tracts are not fully developed. It can occur when infants ingest bacterial spores which colonize and produce toxin in the intestinal tract. This illness is mild in some infants; in others it may be severe.

The two most common foods to cause infant botulism are corn syrup and honey. Symptoms are constipation followed by lethargy, poor feeding, weakness, drooling, weak cry, and loss of head control.

The history of botulism

C. botulinum was first discovered in 1896. Botulism comes from the Latin word "botulus," which means sausage.



Early cases of the illness often came from eating improperly cured sausage.

Today in the United States, sausage is rarely the cause of botulism. Plant products rather than animal products are more commonly the source of organisms. Prior to 1963, most cases of botulism in the United States were traced to home-canned vegetables.

Total cases rarely exceed fifty per year, with the highest ten-year period being from 1930 to 1939 when 384 cases were reported from noncommercial foods. Between 1899 and 1963, 1,561 cases were reported from noncommercial foods, while 219 were reported from commercial foods between 1906 and 1963.

Botulism last occurred in Kansas in July 1995 when an older couple became ill from eating home-canned food.

How can you prevent botulism?

The majority of outbreaks have been caused by home-canned foods. Because *C. botulinum* forms heat-resistant spores, home-canned meat, poultry, fish, and vegetable products require pressure canning to achieve a high enough temperature (240 to 250 degrees Fahrenheit) for a sufficient time to destroy the spores.

It is important to use research-based, up-to-date processing methods. These methods are described in the *USDA Guide to Home Canning*, 1994, and in various Kansas Cooperative Extension publications.

Oven, microwave, and open-kettle canning are definitely out! If you do not have a pressure canner, borrow one or freeze produce instead. If *C. botulinum* bacteria survive and grow inside a sealed jar of food, they can produce a poisonous toxin. *Even a taste of food containing this toxin can be fatal.* Boiling food ten minutes at altitudes below 1,000 ft. destroys this poison when it is present. For altitudes at and above 1,000 ft., add one additional minute per 1,000 ft. additional elevation.

Caution: To prevent the risk of botulism, low-acid and tomato foods not canned according to the recommendations in the *USDA Guide to Home Canning* or according to other USDA-endorsed recommendations should be boiled as above, even if you detect no sign of spoilage. All low-acid foods canned according to the approved recommendations may be eaten without boiling them when you are sure of all the following:

- Food was processed in a pressure canner.
- Gauge of the pressure canner was accurate.
- Up-to-date researched process times and pressures were used for the size of the jar, the style of pack, and the kind of food being canned.
- The process time and pressure recommended for sterilizing the food at your altitude was followed.
- The jar lid is firmly sealed and concave.
- Nothing has leaked from the jar.

■ No liquid spurts out when the jar is opened.

■ No unnatural or "off" odors can be detected.

Because of the potential hazards of improperly home-canned foods, it is also against State of Kansas regulations to serve these foods in foodservice establishments.

Avoid using vacuum packaging machines to enhance storage of leftovers. Store leftover foods and vacuum-packaged meats in the refrigerator or freezer. Do not feed corn syrup and honey to infants or use as a dip for pacifiers.

References

- Adams, M.R., and M.O. Moss. *Food Microbiology*. The Royal Society of Chemistry., 1995, pp. 168-177.
- Applied Foodservice Sanitation, A Certification Coursebook, 4th Ed.* The Educational Foundation of the National Restaurant Association, 1992, pp. 44-45.
- Jay, James M. *Modern Food Microbiology, An AVI Book*. Van Nostrand Reinhold, 4th Ed., 1992, pp. 487-501.
- Miller, Roger W. "How Onions and a Baked Potato Became Sources of Botulism Poisoning." *FDA Consumer*, October 1984.
- Penner, Karen P. *Microorganisms and Foods*. Kansas State University North Central Regional Extension Publication No. 447, 1992.
- USDA Guide to Home Canning*. USDA-ES Agriculture Information Bulletin No. 539, 1994.

Thanks to Dr. Randall K. Phebus, Assistant Professor and Food Microbiologist, Department of the Animal Sciences and Industry, Kansas State University, for reviewing this publication.



Cooperative Extension Service, Manhattan, Kansas

Issued in furtherance of Cooperative Extension Work, acts of May 8 and June 30, 1914, as amended. Kansas State University, County Extension Councils, Extension Districts, and U.S. Department of Agriculture Cooperating, Richard D. Wootton, Associate Director. All educational programs and materials available without discrimination on the basis of race, color, national origin, sex, age, or disability.

November 1995

File Code: Food and Nutrition—5