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Food Preservation Fact Sheet **FP02-22**

Home Canning – History and Safety

All food begins as a living plant or animal. It begins to deteriorate immediately after harvest or slaughter for three reasons: (1) cellular enzymes continue to work, causing cells to continue to metabolize, (2) natural chemicals in the food react with oxygen in the air and with other chemicals, and (3) microorganisms such as yeasts, molds and bacteria begin to grow on and in the food product. Some organisms cause spoilage (making food unacceptable for consumption), while others pose a health hazard (making food unsafe for consumption). The primary objective of food preservation is to preserve food so that it can be safely eaten at a later date. The greatest food safety threat, in terms of lethality, from home-preserved food is the danger of *Clostridium botulinum*. Fresh foods, whether eaten raw or cooked, have never been implicated in an outbreak of botulism. Food preservation methods are designed to prevent the development of botulinum toxin unless the nature of the food itself is inhibitory to the growth of the organism. The target organism for assessing the adequacy of home canning is *Clostridium botulinum*.

For its effectiveness, canning depends on the combined effect of time and increased temperature. As the temperature is raised to the lethal temperature, microorganisms die. The ideal heat treatment would sterilize the food by killing **all** the microbes present; for this to occur, every particle of food in the jar would have to reach the lethal temperature and be held there long enough to kill all the microorganisms. This kind of sterilization has serious effects on food product quality therefore, canning processes have been developed which are a combination of time and temperature for a given food product which will result in "commercial sterility". This process does not necessarily destroy **every organism** but it will guarantee a long storage life.

Living, actively growing food-spoilage bacterial cells can be destroyed by heating to boiling water temperature for a few minutes. However, some bacteria can also exist in a dormant, spore state. In this state they are very heat resistant, and, depending on the acidity of the food, may require temperatures above the boiling point of water for some period of time to be destroyed. Generally, the higher the temperature above boiling, the shorter the time required to kill spores. For home canning, achieving temperatures above the boiling point of water requires a pressure canner. The length of processing time will depend on the acidity of the food, the viscosity (thickness) of the food, and the type and number of microorganisms present.

Our forbearers attempted to preserve foods through the winter in a number of ways. Some of the original home canning methods called for ladling hot foods into stoneware crocks, placing a brandy-soaked parchment (paper) on top of the hot food, then covering the opening with a washed animal bladder and securing it with a leather strap. A variety of methods for "potting"

heated foods were attempted in the early years of home canning with some limited amounts of success.

Milestones to Safe Home Canning (IFT, 1977)

1824: Publication of, *A Treatise of Domestic Medicine Intended for Families*, including canning methods developed by Nicholas Appert, French chef in Napoleon's time.

1850's: Home canning equipment advertised in *Country Gentleman*, which recommended self-sealing cans for home-canned corn and peas.

World War I: Government campaigned to get citizens to grow and preserve food at home to make greater supplies available to the Armed Forces. National War Garden Commission came up with slogans like "Back up the cannon with the canner."

1917: The War Garden Commission and the USDA published the first government pamphlets on home canning including methods such as water-bath and steamer processing of low-acid vegetables, as well as oven canning.

1926: USDA announced that pressure canning was the only safe method for processing low-acid vegetables and meat. However, some of their publications indicated that water-bath-canning was acceptable if that was all that was available.

World War II: Citizens urged to raise Victory gardens and home can foods. The Extension Service established community canneries, clinics and schools for home canners.

1943: USDA issued a firm statement that pressure canning was the only safe way to can-low-acid vegetables and meat.

1946: USDA published results of extensive heat penetration studies on home-canned foods that established a firm scientific basis for home canning.

1976: Sapers et al (1976) found four varieties of tomatoes that had pH values above 4.6 (Garden State, Ace, 55VF and Cal Ace)--these tomatoes must be processed as low-acid foods.

1988: USDA published. *The Complete Guide to Home Canning*, which eliminated all methods except boiling-water-bath for acid fruits, preserves, and pickles, and pressure canning for low-acid vegetables. This guide included recommendations for acidification of tomatoes to be water-bath-canned, and eliminated the use of open-kettle preparation of jams and jellies.

It wasn't until the mid 1940's that a thorough scientific investigation of home canning methods was made. In 1945, Esselen reported that if a boiling-water-bath is used instead of a pressure canner to process low-acid foods, it takes from 5 ½ to 12 hours of boiling to destroy spores of *Clostridium botulinum*. Commercial canners readily adopted new guidelines established by the USDA in 1946--the result was that only 5 botulism deaths could be attributed to commercially canned foods produced since 1940 (in 800 billion containers of canned foods). Most (about 90%) outbreaks and deaths related to botulism can be traced to improperly home-canned low-acid foods. About 25% of all cases are fatal.

Botulism toxin is a neurotoxin that is produced after the spores germinate into living cells. These organisms grow only in low acid, anaerobic (without air) environments. Consumption of the toxin leads to paralysis evidenced by fatigue, weakness, and vertigo, followed by blurred vision, and difficulty in speaking and swallowing. Muscle weakness, labored breathing, abdominal discomfort and distention and constipation may develop 8 to 72 hours after eating food contaminated with preformed botulinum toxin. Death occurs from respiratory paralysis. The type of botulism commonly associated with seafood may cause vomiting, nausea and inflammation of the throat. The growth of *C. botulinum* in foods frequently, but not always, produces a foul, putrid odor that serves as a warning to the consumer. The toxin, once produced, is sensitive to heat such that boiling food for 10 to 20 minutes will inactivate it. Freezing damages neither the spores nor the toxin but will prevent germination of the spores and toxin production **as long as the food is frozen**.

A number of home canning methods that evolved with little scientific investigation to provide safety guidelines are no longer recommended. These include: (1) Open-kettle canning, the method whereby hot food is filled into pre-sterilized jars but jars receive no further processing. (2) Water-bath processing of low acid foods. (3) Oven Canning, the method whereby hot food is filled into pre-sterilized jars, then jars are "baked" in the oven, but reach only about 215°F inside. (4) Other new unsafe methods such as canning in the microwave oven or in a slow cooker.

Factors Affecting the Recommended Methods for Home-Canning

1. The time required for heat to penetrate to the center of the food in the container is extremely important. The heat-penetration rate is affected by:

    A. The size and shape of the container: quarts take longer to heat up than pints.
    B. The ratio of solids to liquid: vacuum-packed corn kernels take longer to heat up than kernels in brine.
    C. The type and size of the pieces in the container: corn and peas heat up faster than yams or boneless chicken breasts.
    D. The amount of fat: fat is a thermal insulator.
    E. The type of heating medium being used: wet steam heats cans faster than dry air.

2. The acidity of the food--using the pH scale as a measure of acidity where 1 = very high acid and 14 = very low acid, the dividing line for high-acid foods and low-acid foods is pH 4.6.

High-acid foods can be water-bath canned (to a temperature of 212° F) while low-acid foods must be pressure canned (to a temperature of 240°F). The reason for this is that the toxin-producing, potentially lethal organism, *Clostridium botulinum*, will not grow and produce toxins at a pH below 4.6. Many spoilage microorganisms will not grow between pH 1 and 4.6 either. The most common spoilage microorganisms associated with high-acid foods are yeasts and molds that can tolerate acid environments.

Home-canning can be a safe and rewarding way to preserve food from the garden, however, changes in the guidelines, new equipment and food-crop varieties make it imperative that the home-canner use up-to-date information. In general, directions for safe home-canning will specify the type of food, the size of pieces or preparation techniques, the style of pack, the size of container, the type of canner, the time for water-bath canning, the pressure and time for both dial and weighted gauge pressure canners, instructions for removing the canned food from the canner, handling of the jars during the cooling period, and storage of the home canned product. Adhering to these guidelines will help increase your chances of successful canning, however in the event that some jars do not seal, or the food spoils during storage, handle the food according to USDA recommendations for reprocessing or disposal of spoiled food. The USDA Cooperative Extension Service is one good source of current information on recommended methods. Presently the Cooperative Extension Service of the University of Georgia provides national leadership for home food preservation research and education.

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