
Food Safety Basics

The quality of food is judged by wholesomeness, its nutritional value, and our expectations of its color, flavor, odor, and texture. The quality of preserved food varies greatly and depends mostly on the quality of the fresh food and preservation methods. High quality preserved foods are free from microbial spoilage and toxins, are pleasing to eat, and are reasonably nutritious.

Causes of Food Spoilage & Deterioration

Food spoilage is the process of food becoming unsafe or unacceptable for human consumption. There are five general causes of food deterioration:

Microbial Spoilage

The most common cause of food spoilage is the growth of bacteria, molds, or yeast that are naturally occurring microscopic organisms. Thousands of species exist in nature and are widely found in the soil, water, and air.

- **Bacteria:** There is a full spectrum of bacteria from desirable to deadly. *Lactobacillus* is a desirable bacteria involved in fermentation processes to produce cheese, pickles, and sauerkraut. An example of a “bad” or pathogenic bacteria is *Clostridium botulinum*, which under the right circumstances causes botulism poisoning, a very serious and sometimes deadly illness. Proper canning of low-acid foods (vegetables, fish, meat) by using a pressure canner is required to kill this odorless, tasteless, and colorless toxin.
- **Molds:** Molds grow on most foods and are easily recognized by their masses of fuzzy growth in a variety of colors. The roots of mold can spread invisibly through soft foods, thus removing the surface mold does not eliminate mold from the food. Molds grow best at room temperature, but some can grow (slowly) at refrigerator temperatures. They are relatively tolerant of common inhibitors, acid and salt. Molds require oxygen, so wrapping food tightly will reduce the opportunity for mold growth. Molds are easily killed by heat. Most begin to die at about 140° F and almost all are dead when food temperatures reach 190° F.
- **Yeasts:** Yeasts can grow with or without air and require more water than molds. Their masses in or on food appear as slime, scum, or murkiness. Yeast fermentation in food is recognized by gas bubbles, froth, or foam which result from the fermentation activity and the production of carbon dioxide gas. Depending on the specific growth conditions, yeast produce acids (vinegar), alcohol (beer and wines), or carbon dioxide (raised bread) during fermentation. This can be desirable or result in spoiled food. Yeast grow best at room temperatures and are destroyed by heating foods to temperatures of 140° F to 190° F. They grow slowly on refrigerated foods. Yeasts grow best on or in acidified foods and fruits. Yeast growth in these foods can raise the pH, changing the conditions to be more favorable for bacterial growth.

Enzyme Action

The activity of enzymes naturally present in foods results in changes in appearance, texture and flavor, and loss of vitamins. Enzymes are easily inactivated by quickly heating raw food to temperatures of 170° F to 190° F in boiling water, in steam, or with a microwave oven. This is the purpose of blanching vegetables before freezing or drying.

Oxygen

The presence of oxygen causes oxidation, which causes many color and flavor changes, including rancidity of fats. Oxygen can also increase activity of many chemical substances in food. Good airtight packaging, careful wrapping of food to exclude oxygen and vacuum packaging machines are all good ways to exclude oxygen and improve the shelf life of stored food.

Insect Infestation

Some unavoidable insect eggs are contained in freshly harvested foods. If they are not controlled, the eggs will hatch and become larvae that will burrow through these foods to eat. Inspect food carefully, use good sanitation practices, and store food in covered containers. If insects are found, locate and discard all infested foods and clean storage areas thoroughly.

Moisture Loss

Loss of moisture changes food quality. Moisture loss proceeds more rapidly at higher temperatures. Refrigeration and proper packaging of fresh food keep these changes to a minimum.

Methods of Food Preservation

Food preservation is the maintenance of safe and nutritious food for an extended period of time. The primary methods of preserving food include the following:

Refrigeration

- Retards growth of microorganisms
- Slows action of enzymes

Freezing

- Prevents growth of microorganisms, but does not necessarily kill them.
- Kills insect eggs and larvae.
- Slows, but does not stop enzymatic activity. Therefore, enzymes present in most fresh vegetables must be inactivated by blanching before freezing.
- For highest quality, lower the food temperature to 0° F as rapidly as possible and maintain a 0° F food temperature.
- Freeze only the amount you can use before its shelf life expires.
- Use packaging that is moisture proof, sealable, and oxygen impermeable to retain quality.

Canning

- With proper canning practices, air is forced from the jars, leaving a vacuum. Processing heat destroys the most heat-resistant microorganisms capable of growing in food stored at room temperature.
- The amount and method of heat processing used depends mainly on the acidity in food. Acidity may be natural, as in most fruits, or added, as in pickled food. Low-acid canned foods contain too little acidity to prevent the growth of heat-resistant bacteria. Acid foods contain enough acidity to block their growth or destroy them more rapidly when heated.
- Molds and some yeast are unable to grow in a vacuum. However, there is a very healthy growth environment for some bacteria in sealed, low-acid home-canned foods. Such foods must be heat processed until a commercially sterile product is achieved, or they must have salts, sugars, acids, or other preservatives added.
- Yeasts and molds are destroyed when food temperatures reach about 190° F, whereas most bacterial vegetative cells are destroyed in foods heated to a boiling temperature. Bacterial spores are able to survive for a long period at the temperature of boiling water.
- Pressure enables the processing of canned foods at temperatures higher than boiling water, where kill rates of bacteria are greatly increased. Pressure canning is required to safely process low-acid foods that may support the growth of bacterial spores.

- It is the scientific study and research of these food spoilers that has resulted in different canning methods (boiling water, atmospheric steam canning, and pressure canning) that allow the home canner to safely process and store foods. A list of approved sources that base their recipes and preservation methods on research findings is included below and should be the exclusive reference for all home canners.

Dehydrating

- Removes water and prevents growth of microorganisms.
- Microorganisms require water for growth. Removal or reduction of water from a food prevents growth of microorganisms and controls enzyme activity.
- Dried foods must be packaged in oxygen and moisture proof containers to prevent oxidation of flavors and moisture gain.

Pickling and Fermenting

- These methods (and others, like canning naturally acidic fruits, jams and jellies) use either naturally produced or added acids to inhibit or prevent the growth of many microorganisms. Foods that contain enough acid to inhibit the growth of *Clostridium botulinum* are called high acid foods (pH lower than 4.6). The presence of acids in foods, however, does not kill organisms.
- Fermenting uses bacteria to produce lactic acid and lower the pH in products such as fermented pickles and sauerkraut.
- Pickling adds vinegar (acetic acid) to lower pH in fresh pack pickles and other acidified products.

Salting

- Chemically bonds water, inhibiting growth of some bacteria.

Sweetening and Acidifying Jellies and Jams

- Adds sugar and acids that tie up free water and lower the pH.

On Guard Against Spoilage

Don't taste or use canned foods that show any sign of spoilage! Look closely at all jars before opening them. A bulging lid or leaking jar is a sign of spoilage. When you open the jar, look for other signs, such as, spurting liquid, an off-odor or mold. Spoiled canned foods should be discarded in a place where they will not be eaten by humans or pets.

Don't taste or use improperly canned, low-acid foods! Low acid foods include vegetables, meat, seafood and tomatoes. Improperly canned, low-acid foods can contain the toxin that causes botulism **without showing signs of spoilage**. Jars of foods that have not been properly processed must be discarded, even if there are no signs of spoilage, or if they are unsealed, open or leaking they must be detoxified and discarded as directed below. Low-acid foods are considered improperly canned if any of the following are true:

- The food was not processed in a pressure canner.
- The gauge of the canner was inaccurate.
- Up-to-date researched processing times and pressures were not used for the size of the jar, style of pack or kind of food processed.
- Proportions of ingredients were changed from the original approved recipe.
- The processing time and pressure were not correct for the altitude at which the food was canned.

How to Detoxify Canned, Low-Acid Foods

Contact with botulinum toxin can be fatal whether it is ingested or enters through the skin. Be extremely careful not to splash or come in contact with the suspect food or liquid. Wear disposable rubber or heavy plastic gloves. Wear clothes and aprons that can be bleached or thrown out if contaminated.

Step-by-Step Instructions for Detoxification:

- Carefully place the jars, with their lids, on their sides in an 8-quart, or larger pot or canner.
- Wash your gloved hands thoroughly.
- Carefully, without splashing, add enough hot water to the pot to completely cover the jars with at least 1 inch of water above the containers.
- Place a lid on the pot and heat the water to boiling.
- Boil for 30 minutes to make sure the food and containers are detoxified.
- Cool and discard the containers, their lids and food in the trash or dispose in a nearby landfill.

How to Clean Up Contaminated Surfaces:

- Wear rubber or heavy plastic gloves to clean up contaminated work surfaces and equipment, including can openers and clothing that may have come in contact with suspect foods or liquids.
- Use a fresh solution of 1 part unscented, liquid, household, chlorine bleach (5 to 6% sodium hypochlorite) to 5 parts clean water.
- Spray or wet contaminated surfaces with the bleach solution and let stand for 30 minutes. Avoid inhaling bleach or contact with skin.
- Wipe treated spills with paper towels and place paper towels in a plastic bag before putting them in the trash.
- Apply the bleach solution to all surfaces and equipment again, and let stand for 30 minutes and rinse.
- Wash all detoxified counters, containers, equipment, clothing, etc.
- Discard gloves when cleaning process is complete.

A good rule to follow is: When in doubt, throw it out! If food looks or smells strange, don't take a chance by tasting it and don't give it to your pets or other animals. Throw it out!

Research-Based Sources

Research-Based Sources for Canning and Other Food Preservation:

- National Center for Home Food Preservation (<http://nchfp.uga.edu/>)
- USDA Guide to Home Canning, 2015
- So Easy to Preserve 6th Edition, September 2014 (University of Georgia)
- The Ball Blue Book Guide to Preserving, 2014
- Ball Complete Book of Home Preserving, 2012
- University of California Publications
- Cooperative Extension Offices (all 50 states)
- Package inserts included with name-brand pectins
- For more links: <http://mfp.ucanr.edu>

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