

Fermenting Vegetables

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Many foods are fermented to extend the shelf life and develop desired flavors. Low acid vegetables commonly fermented include cabbage and cucumbers. Fermentation of these products is accomplished by a partial breakdown of the carbohydrates (starches and sugars) within the foods by specific microorganisms. When microorganisms break down carbohydrates, an acid is produced.

The production of acid lowers the pH level, therefore changing the vegetables from “low acid” to “high acid”. The pathogenic microorganism *Clostridium botulinum* is not capable of growing and producing its deadly toxin in a high acid food (pH < 4.6). Some microbes do survive in a high acid environment, particularly yeasts and molds; therefore, fermented vegetables are not shelf-stable in a hermetically sealed jar until they are heat processed with a boiling water bath canner.

The fermentation process occurs without the presence of oxygen (anaerobic). The growing conditions - temperature, time, salt and sugar concentrations - are favorable for specific fermenting bacteria that are naturally present on cabbage or cucumbers. For example, the bacteria *Leuconostoc mesenteroides* is mostly associated with pickle and sauerkraut fermentation. This organism tolerates high concentrations of salt and sugar.

When making fermented products, use the following safety tips:

- Use tested recipes: Refer to the National Center for Home Food Preservation (http://nchfp.uga.edu/how/can6a_ferment.html)
- Never alter the recipe: the proportions of salt, vinegar, produce and water (recommend soft) must be followed.

- Use 5% white distilled or cider vinegar (50 grain). Never use homemade vinegar.
- Use canning or pickling salt. Never cut back on the salt when making fermented pickles. Salt is critical for the growth of lactic acid, producing bacteria and inhibiting the growth of spoilage microbes. Salt also contributes to flavor, texture and safety.
- Follow the recommendations for time, temperature, containers and weights.
- Use fresh, clean produce (this includes the dill for cucumbers).
- Thoroughly wash and clean all equipment and produce.

Special Considerations for Sauerkraut

- Shred or slice cabbage (1/4 inch thick).
- Use the following steps when packing the salt into the cabbage:
 1. Measure 5 pounds of cabbage into the fermenting container.
 2. Sprinkle 3 tablespoons of canning salt over the cabbage.
 3. With clean hands, mix using a twisting punch motion to work in the salt until juices are drawn from the cabbage.
 4. Repeat steps 1 through 3, not going closer than 4 or 5 inches from the container rim.
- Follow the recipe.

Special Considerations for Fermented Dill Pickles

- A brine of salt, vinegar and water is added to the cucumbers, dill and other spices.
- Discard 1/16 inch from the blossom end of a cucumber (this will prevent excessive softening of pickles).
- Leave ¼ inch of stem attached.

- Avoid fermentation temperatures greater than 80°F.
- The firming agent, alum, may be safely used only with fermented dill pickles (however, it is unnecessary and not included in many recipes).

Suitable Containers, Covers and Weights for Fermenting Food

A 1-gallon container is needed for each 5 pounds of fresh vegetables. Therefore, a 5-gallon stone crock is of ideal size for fermenting about 25 pounds of fresh cabbage or cucumbers. Food-grade plastic and glass containers are excellent substitutes for stone crocks. Other 1- to 3-gallon non-food-grade plastic containers may be used if lined inside with a clean food-grade plastic bag.

Caution: Be certain that foods contact only food-grade plastics. Do not use garbage bags or trash liners. Fermenting sauerkraut in quart and half-gallon Mason jars is an acceptable practice, but may result in more spoilage losses. If using half-gallon jars, transfer to quart or pint jars before processing in a boiling water bath canner.

Submerge cabbage and cucumbers 1 to 2 inches under brine while fermenting.

1. After adding prepared vegetables and brine, insert a suitably sized dinner plate or glass pie plate inside the fermentation container. The plate must be slightly smaller than the container opening, yet large enough to cover most of the shredded cabbage or cucumbers.
2. To keep the plate under the brine, weight it down with 2 to 3 sealed quart jars filled with water.
3. Fine quality fermented vegetables are also obtained when the plate is weighted down with a very large clean, plastic bag filled with 3 quarts of water containing 4-1/2 tablespoons of salt. Seal the plastic bag. (Freezer bags sold for packaging turkeys are suitable for use with 5-gallon containers.)
4. Covering the container opening with a clean, heavy bath towel helps to prevent contamination

from insects and molds while the vegetables are fermenting.

End of Fermentation Process

- Fermentation is completed when the bubbling ceases.
- Approximate fermentation time is three to four weeks in an air temperature of 70 to 75F, and five to six weeks at 60 to 65 F.

Storage Options

- The finished product can be stored in the refrigerator for several months, or
- Made shelf stable by processing in a boiling water bath. Refer to the USDA home canning guides for heat processing methods. http://nchfp.uga.edu/how/can6a_ferment.html
- Sauerkraut can be frozen (not recommended for pickles).

Definitions:

Clostridium botulinum: a spore forming bacteria that are anaerobic (reproduces well when no oxygen is present) and does NOT reproduce when the pH is below 4.6. When Clostridium botulinum reproduces, it forms the deadly toxin "botulinum".

Brine: saturated salt solution (normally with water). Other ingredients and seasonings can be included in the brine

Resources:

This document was adapted from the "Complete Guide to Home Canning," Agriculture Information Bulletin No. 539, USDA, revised 2009.