

Fermentation — Sauerkraut and Pickles

Fermenting is the process in which beneficial bacteria break down food components under controlled, anaerobic conditions to produce acids. This improves the taste, texture, and shelf life of the food. Maintain a high level of cleanliness and follow research-tested procedures to have the greatest success in producing safe, high-quality products. Start with clean countertops and utensils. Wash hands with soap and warm water. All produce should be properly washed before it is consumed or preserved.

Containers for Fermenting

Stone crocks are the traditional fermentation container; however, other containers, such as glass or food-grade plastic containers, may be used. Many restaurants receive foods and ingredients in 5-gallon plastic buckets, which make ideal fermentation containers. Do not use copper, iron, or galvanized metal containers or lead-glazed crocks. If you are unsure about the suitability of a container, you may line it with a food-grade plastic bag, such as one designed for roasting or brining turkeys. Do not use garbage bags or trash liners.

Covering

To avoid surface mold growth, keep the cabbage or pickles submerged at all times. If the juice does not cover the cabbage or pickles, add boiled and cooled brine prepared with 1½ tablespoons of salt in a quart of water. Cover the cabbage or pickles with a plate just small enough to fit inside the fermentation container and weigh it down with two or three clean quart jars filled with water. An acceptable alternative is to fill a large, sealed, food-grade plastic bag containing 4½ tablespoons of salt and 3 quarts of water. The filled bag may be inserted into another bag and sealed for added strength. Plastic bags sold for roasting or brining turkeys are the right size for 5-gallon containers. Cover the top of the container with several layers of clean cheesecloth or a clean kitchen towel to reduce exposure to airborne mold spores.

SAUERKRAUT

Recommended Varieties

Bravo, Danish Ballhead, Excalibur, Murdoc, Premium Late Dutch, Late Flat Head, and Krautman are good varieties for sauerkraut. Late season cabbage is desirable for making sauerkraut.



Photo credit: Steve Williams, Penn State

Quantity

A 50-pound bag of fresh cabbage makes 16 to 20 quarts of sauerkraut. A 1-gallon stone crock holds 5 pounds of shredded cabbage, and a 5-gallon crock holds 25 pounds.

Quality

To make good sauerkraut, use disease-free, firm, sweet, mature heads of cabbage from mid- and late season crops. Prepare and start the fermentation one to two days after harvesting the cabbage.

Preparation

Work with about 5 pounds of fresh cabbage at a time. Discard outer leaves. Rinse heads with cold water and drain. Cut heads in quarters, remove cores, and trim and discard worm- and disease-damaged tissue. Shred or slice cabbage to a thickness of a 25-cent coin, or ¼ of an inch (1.5 mm).

Filling and Packing the Container

Place 5 pounds of shredded cabbage in the fermentation container and thoroughly mix in 3 tablespoons of canning or pickling salt. Pack, pound, or squeeze the mixture with clean hands until the level of natural juices drawn from the cabbage covers its surface. Continue preparing and packing 5-pound quantities of shredded cabbage and 3 tablespoons of salt at a time until finished, or until the fermentation container is filled within three (7.5 cm) to four inches (10 cm) from its top. Weigh down and cover the cabbage as described in the “Covering” section at the beginning.

The exact ratio of 3 tablespoons of canning or pickling salt to 5 pounds of shredded cabbage controls pathogen growth. Changing the proportions could result in an unsafe product.



Fermentation Temperature, Time, and Management

Store the container at 70°–75°F (21°–23°C) while fermenting. At these temperatures, sauerkraut will be fully fermented in about three to four weeks; at 60°–65°F (15°–18°C), fermentation may take six weeks. Below 60°F (15°C), sauerkraut may not ferment. Above 80°F (26°C), sauerkraut may become soft and spoil.

Fermentation naturally stops because the acids accumulate to such an extent that further growth cannot take place. If you submerge the cabbage with a brine-filled bag, do not disturb the crock until the normal fermentation is complete (when bubbling ceases). If you use jars as weights, you must check the sauerkraut two to three times each week and remove scum if it forms. Sauerkraut should be to desired tartness, with firm texture, have brine that is not cloudy, and be free of any sign of mold or yeast growth. Do not taste if you see mold on the surface, feel a slimy texture, or smell a bad odor. Fully fermented sauerkraut may be kept tightly covered in the refrigerator for several months, or it may be canned and frozen.

Freezing Procedure

Don't freeze more than 2 pounds of food per cubic foot of freezer capacity per day. Fill pint or quart plastic freezer containers or tapered freezer jars. Allow ½ inch (13 mm) of headspace, seal, label, and freeze.

Canning Procedure

Read “Let's Preserve: Basics of Home Food Preservation” before starting. Wash jars. Prepare lids according to manufacturer's instructions. If there is not enough juice to cover the cabbage in each jar, add boiled and cooled brine prepared with 1½ table-spoons of salt in a quart of water.

To Make a Hot Pack

Bring sauerkraut and liquid slowly to a boil in a large kettle, stirring frequently. Remove from heat and fill jars rather firmly with sauerkraut and juices, leaving ½ inch (13 mm) of headspace. Wipe sealing edge of jars with a clean, damp paper towel. Add lids and tighten screw bands. Process for the recommended time according to Table 1.

To Make a Raw Pack

Fill jars firmly with unheated sauerkraut and cover with juices, leaving ½ inch (13 mm) of headspace. Fill and seal as previously described for a hot pack and process for recommended time (see Table 1).

To Process in a Boiling Water Canner

Preheat canner filled halfway with water to 180°F (82°C) for hot packs and 140°F (60°C) for raw packs. Load sealed jars onto the canner rack. Lower with handles in the preheated boiling water canner, or load one jar at a time with a jar lifter. Add water, if needed, to 1 inch (2.5 cm) above jars and cover. Bring water to boil over high heat. When water boils vigorously, lower heat to maintain a gentle boil and process for recommended time (see Table 1).

To Process in an Atmospheric Steam Canner

Read “Let's Preserve: Basics of Home Food Preservation” before starting. Preheat the base of a steam canner that has been filled with the amount of water designated in the instruction manual that comes with the canner (usually about 2 quarts). Set the rack in the base of the canner. Heat water in the base of the canner to 180°F (82°C). As each jar is filled, place it on canner rack, keeping the cover or lid on the atmospheric steam canner as you work. When all jars are in the canner, bring the canner to a boil over medium to medium-high heat until a steady column of steam at least 6 inches (15 cm) long escapes from the vent hole(s). Processing time begins when there is a steady column of steam 6 (15 cm) to 8 inches (20 cm) long. Slowly adjust the heat to maintain a steady column of steam throughout the processing time.

After Processing

When processing is complete, turn off heat. Allow the jars to sit in the covered canner for 5 minutes before removing them from

Caution: The only research-based recipes for fermented vegetables include procedures for sauerkraut and fermented pickles.



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Table 1. Recommended process times for sauerkraut in a boiling water or atmospheric steam canner at designated altitudes.

Style of pack	Jar size	Process time (in minutes) at altitudes of			
		0–1,000 ft.	1,001–3,000 ft.	3,001–6,000 ft.	Above 6,000 ft.
Hot	Pints	10	15	15	20
	Quarts	15	20	20	25
Raw	Pints	20	25	30	35
	Quarts	25	30	35	40

the canner with a jar lifter, being careful not to tilt the jars, to a wooden cutting board or towel-lined surface.

Do not retighten screw bands. Cool jars for 12 to 24 hours and remove screw bands. Check lid seals. If the center of the lid is indented, the jar is sealed. Wash, dry, label, and store sealed jars in a clean, cool, dark place. If lid is unsealed, examine and replace jar if defective, use new lid, and reprocess as before or store in the refrigerator. Wash screw bands and store separately. Canned goods are best if consumed within a year and are safe as long as lids remain vacuum sealed.

Small-Batch Fermentation

Sauerkraut may be fermented in small batches in quart or half-gallon jars. Spoilage is of greater concern when fermenting in jars because it is harder to keep the cabbage submerged below the brine. For the best success, it is important to ensure thorough mixing of cabbage and salt before packing into sterilized jars.

Procedure

Five pounds of cabbage makes about two 1-quart jars or one half-gallon jar. Sterilize the jar(s) by placing a rack in the bottom of a large pot, covering with water, and boiling for 10 minutes. Allow jar(s) to cool before using. Shred the cabbage as directed in the previous section on preparation of sauerkraut. When fermenting in jars, use the ratio of 5 pounds of cabbage to 3½ tablespoons of canning salt. Thoroughly mix the salt into the cabbage in a large bowl and allow the cabbage to wilt for 10 minutes to draw out liquid. Massage, tamp, and squeeze the cabbage until it becomes soft and juices accumulate at the bottom of the bowl.

Pack the cabbage into the cooled jars, making sure to add any remaining juices from the bowl. Use your hand or a wooden spoon to press the cabbage into the jar and release any air pockets, leaving about 2 inches (5 cm) of headspace above the cabbage. If the juice does not cover the cabbage completely, add boiled and cooled brine (1½ tablespoons canning salt per quart of water). Top with a square of cheesecloth, tucking it in around the sides. Use a paper towel to remove any loose cabbage pieces from the inside of the jar that are above the cheesecloth.

Weigh the cabbage down using a 4-ounce jelly jar filled with brine that fits inside the opening, or use a sealed food-grade plastic bag filled with brine. Cover loosely with a lid or a clean towel so that gases produced during fermentation can escape. Alternately, you may use commercially available weights and one-way valve covers. Place the jar on a tray to catch any juices that might bubble out during the fermentation process. Check the jar two or three times per week and promptly remove any scum or mold. Fermentation at room temperature should



take about three weeks.

Small-batch-fermented sauerkraut may be stored for several months in the refrigerator, frozen, or water bath canned. If canning, follow the procedure described above using a clean jar.

FERMENTED PICKLES

Recommended Varieties

Use a pickling variety cucumber such as Carolina or Bush Pickle. Pickling cucumbers are short and have thin skins. Slicing or table cucumbers are not suitable for fermenting pickles.

Quantity

An average of 4 pounds of 4-inch (10 cm) pickling cucumbers fills a 1-gallon container.

Quality

Cucumbers should be fresh, firm, and free of rot or disease. Use appropriately sized cucumbers for fermenting. Use large or oddly shaped cucumbers for relish.

Preparation

Select 4-inch (10 cm) cucumbers for fermenting. Use the following quantities for each gallon capacity of your container:

- 4 pounds of 4-inch (10 cm) pickling cucumbers
- 2 tablespoons dill seed or 4 to 5 heads fresh or dry dill weed
- ½ cup canning and pickling salt
- ¼ cup vinegar (5 percent)

Caution: If the pickles become soft, slimy, or develop a disagreeable odor, discard them.

Table 2. Recommended process times for fermented pickles in a boiling water or atmospheric steam canner at designated altitudes.

		Process time (in minutes) at altitudes of		
Style of pack	Jar size	0–1,000 ft.	1,001–6,000 ft.	Above 6,000 ft.
Pack	Pints	10	15	20
Raw	Quarts	15	20	25

- 8 cups water and one or more of the following ingredients:
 - 2 cloves garlic (optional)
 - 2 dried red peppers (optional)
 - 2 teaspoons whole mixed pickling spices (optional)

Procedure

Wash cucumbers. Rub each cucumber under running water to loosen and remove soil. Cut ¼-inch (1.5 mm) slice off blossom end and discard. The blossom end contains enzymes that can cause the cucumbers to soften during fermentation. Leave ¼ inch (6 mm) of stem attached. Place half of dill and spices on bottom of a clean, suitable container. Add cucumbers, remaining dill, and spices. Dissolve salt in vinegar and water and pour over cucumbers. Add suitable cover and weight. Store where temperature is between 70°–75°F (21°–23°C) for about three to four weeks while fermenting. Temperatures of 55°–65°F (12°–18°C) are acceptable, but fermentation will take five to six weeks. Avoid temperatures above 80°F (26°C), or pickles will become too soft during fermentation. Fermenting pickles cure slowly. Check the container several times a week and promptly remove surface scum or mold.

Storage

Fully fermented pickles may be stored in the original container for about four to six months, provided they are refrigerated and surface scum and molds are removed regularly. Canning fully fermented pickles is a better way to store them.

Canning Procedure

Read “Let’s Preserve: Basics of Home Canning” before starting. Wash jars. Prepare lids according to manufacturer’s instructions.

Pour the brine into a pan, heat slowly to a boil, and simmer 5 minutes. Filter brine through paper coffee filters to reduce cloudiness, if desired. Fill jar with pickles and hot brine, leaving ½ inch (13 mm) of headspace. Adjust lids and process as described above under “To Process in a Boiling Water Canner” or “To Process in an Atmospheric Steam Canner” for the times listed in Table 2, or use the low-temperature pasteurization treatment described below.

Low-Temperature Pasteurization

The following method may be used to process fermented pickles. Place jars in a canner filled halfway with warm 120°–140°F (48°–60°C) water. Then add hot water to a level 1 inch (2.5 cm) above jars. Heat the water enough to maintain a temperature of 180°–185°F (82°–85°C) for 30 minutes. Check with a candy or jelly thermometer to be certain the water temperature is at least 180°F (82°C) during the entire 30 minutes. Temperatures higher than 185°F (85°C) may cause unnecessary softening of pickles.

For additional information about food preservation, visit the Penn State Extension Home Food Preservation website at extension.psu.edu/food/preservation or contact Penn State Extension in your county.

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