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Garlic: Safe Methods to Store, Preserve, and Enjoy

What Is Garlic?

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Garlic (*Allium sativum*) is a member of the amaryllis family (Amaryllidaceae), which also includes leeks, onions, and shallots. The garlic bulb, or head, is composed of 4 to 20 pungent bulblets commonly called cloves.

There are two main types of garlic: softneck (*Allium sativum* var. *sativum*) and hardneck (*Allium sativum* var. *ophioscorodon*). Most commercial varieties are softneck, and the bulbs have numerous smaller cloves (fig. 1). Many home gardeners also grow hardneck varieties, which produce a green stalk, or "scape," in the spring, and have bulbs with fewer but larger cloves. Elephant garlic (*Allium ampeloprasum* var. *ampeloprasum*) is not true garlic—it is a close relative of the leek, and the bulb has very large, mild-flavored cloves.

California produces over 90 percent of the garlic grown commercially in the United States. California Early and California Late are the major commercial varieties. California Early has a white skin and is planted in November for harvest in June. California Late has a light purple skin and is planted in December for harvest in July and August.

The pungent flavor of fresh garlic results from a chemical reaction that occurs when the clove cells are broken and release both the enzyme alliinase and the compound alliin. The enzyme converts alliin to allicin, the chemical primarily responsible for garlic's distinct flavor. The flavor is most intense shortly after cutting or chopping because allicin is unstable and is quickly broken down to other compounds. This chemical reaction cannot occur after garlic is cooked because the enzyme is destroyed by cooking. This is why roasted garlic is sweet rather than pungent.

Figure 1. Cross-section of two heads of garlic: a hardneck variety (left) and a softneck variety (right). *Photo:* Sheryl Yamamoto

Research on food preservation is ongoing—recommendations may change. Make sure your food preservation information is always current. Always follow up-to-date, tested guidelines and recipes from reliable sources.

Harvesting Garlic

The appropriate time to harvest garlic depends on the time of planting and your local climate. Look for the bottom leaves on the stalk to turn brown (while the upper leaves remain green). Lift the garlic from the soil using a garden tool rather than pulling on the stems, and then brush off the soil. You may rinse the soil from the bulbs and roots. If you grow your own garlic, let the mature bulbs cure (dry) after harvest so that they do not rot during storage. Choose a well-ventilated location that is sheltered from direct sunlight and rain. You can cut off the leaves and roots before drying, but leaving them on can facilitate drying. Spread the harvested garlic bulbs on newspapers or wire racks or gather them by the stalks (in bunches of about 10 plants), tie them together, and hang them up. The outer skins will become papery in about 2 to 3 weeks—the total curing time depends on the surrounding temperature and humidity. Elephant garlic requires slightly longer curing; for best flavor and stability you may want to cure it for 4 to 6 weeks. After curing, cut off the tops and roots and remove the outermost layer of skin.

Buying Garlic

Select garlic bulbs that are clean, firm with tight unbroken skins, have no signs of molding or sprouting, and are heavy for their size (garlic bulbs that are light in weight for their size may have shriveled or decayed cloves). The papery skin of some garlic varieties naturally have purple, purple-striped, or reddish coloring—these varieties often have a rich, robust flavor.

Storing Garlic

Softneck varieties of garlic will store for longer than hardneck varieties. Softneck garlic can be kept in good condition under commercial storage conditions for up to 9 months when held near 32°F (0°C), or for 1 to 2 months at ambient temperatures of 68° to 86°F (20° to 30°C). Hardneck garlic will store for up to 6 months under ideal conditions. The home refrigerator (typically 40°F, or 4°C) is not suitable for optimal long-term storage of garlic because holding garlic at that temperature stimulates sprouting. Instead, store both hardneck and softneck garlic bulbs in a cool, dry, well-ventilated place in well-ventilated containers such as mesh bags. Storage life is 3 to 5 months under cool (60°F, or 16°C), dry, dark conditions. When stored too long the garlic cloves may shrivel or begin to sprout. Neither is harmful, but both are an indication that the garlic is no longer at its peak quality. If the garlic has sprouted, the clove can be cut in half and the center green sprout removed and discarded.

Peeling Garlic Cloves

The papery skin is usually removed from garlic cloves before use. A quick way to peel garlic is to press firmly on the clove with the flat side of a knife until the clove and skin crack; the skin can then be easily removed. Or, to peel cloves while keeping them intact, place the clove inside a silicone or rubber sheet formed into a tube and roll the heel of your hand against the top of the tube until the skin separates.

Freezing Garlic

Garlic can be prepared in a number of ways for freezing.

1. Chop garlic, wrap it tightly in a plastic freezer bag or in plastic wrap, and freeze. To use, grate or break off the amount needed.
2. Place garlic bulbs or cloves (peeled or unpeeled) in a freezer bag or container and freeze; remove cloves as needed.
3. Peel the cloves, purée them with oil in a blender or food processor using 2 parts oil to 1 part garlic, and pack the mixture into an airtight container. (The puree will stay soft enough in the freezer to scrape out portions to use in sautéing.) Freeze this mixture immediately—**do not hold or store it at room temperature**. The combination of the low-acid garlic, the exclusion of air (by mixing with oil), and room-temperature storage can support the growth of *Clostridium botulinum* (see the sidebar "Botulism Warning").

Drying Garlic

Dry only fresh, firm garlic cloves with no bruises. To prepare, separate and peel the cloves and cut them in half lengthwise. No additional predrying treatment is necessary. Follow the drying instructions supplied with your dehydrator or use the following method. Dry prepared cloves in a dehydrator at 140°F (60°C) for 2 hours, then reduce heat to 130°F (55°C) and continue drying for another 4 to 6 hours until brittle or crisp. The clove halves should not be pliable but should break if bent. Pack dried garlic in an airtight container and store it at room temperature or in the freezer.

If desired, make garlic salt from the dried garlic. To prepare, process dried garlic in a blender or food processor until fine. Add 4 parts salt to 1 part garlic powder and blend 1 to 2 seconds. If blended longer, the salt will become too fine and will cake together in clumps.

Canning Garlic

CAUTION: Canning garlic is not recommended. Garlic is a low-acid vegetable that requires a pressure canner to be properly processed. Garlic loses most of its flavor when heated in this way. For this reason, adequate processing times have not been determined for canning garlic.

Botulism Warning

Garlic is a low-acid vegetable. The pH of a clove of garlic typically ranges from 5.3 to 6.3. As with all low-acid vegetables, garlic will support the growth and subsequent toxin production of the bacterium *Clostridium botulinum* under the right conditions. These conditions include home canning and improper preparation and storage of fresh garlic-in-oil mixtures. Moisture, room temperature, lack of oxygen, and the low-acid nature of garlic all favor the growth of *Clostridium botulinum*. When this bacterium grows it produces an extremely potent toxin. Eating a food containing the toxin causes the illness botulism, which can result in paralysis and death within a few days if not treated. It is important to follow the directions in this publication carefully to make sure your preserved garlic is safe to eat.

Storing Garlic in Wine or Vinegar and Refrigerating

Peeled cloves may be submerged in undiluted (full-strength) wine or vinegar and stored in the refrigerator. Adding wine or vinegar to garlic provides an acidic environment (less than pH 4.6) so that *Clostridium botulinum* cannot grow. A dry white or red wine is suggested; white or wine vinegars also work well, but balsamic vinegar may be too strongly flavored. You may also add a small amount of dried spices, such as peppercorns, hot chili flakes, cumin seeds, or bay leaves, if desired. The garlic-flavored liquid and the garlic cloves may be used to flavor dishes. The garlic–liquid mixture should keep for about 4 months in the refrigerator. Label the refrigerated garlic–liquid mixtures to show the preparation date and a "best before" date. Longer storage should not result in an unsafe product, but mold growth may develop and flavors may change. **Do not store the garlic–liquid mixture at room temperature because it will rapidly develop mold growth.** Discard both the cloves and the liquid if there are signs of mold or yeast growth on the surface of the wine or vinegar.

Storing Garlic in Oil

Take extreme care when preparing flavored oils with fresh garlic or when storing fresh garlic in oil. Peeled garlic cloves may be submerged in oil and stored in the freezer for several months or in the refrigerator for no more than 4 days. Label refrigerated garlic in oil mixtures to show the preparation date (or preferably with a "discard after date" label). **Do not store garlic in oil at room temperature.** Garlic in oil mixtures stored at room temperature provide an ideal environment for *Clostridium botulinum* to grow and produce toxin (low acidity, no free oxygen in the oil, and warm temperature). The same hazard exists for roasted garlic stored in oil. At least four outbreaks of botulism associated with garlic in oil mixtures have been reported in North America in the late 1980s and 1990s. Outbreaks in 1991 (California) and 1999 (Florida) were associated with garlic in oil prepared in the home.

Figure 2. Materials for making acidified garlic in oil. Note that parsley should not be added to the garlic and oil mixture. *Photo:* Sheryl Yamamoto

Dried Garlic in Oil

Fully dried (brittle or crisp) whole, sliced, or chopped garlic may be safely used to flavor oils as long as the garlic has not been rehydrated and care is taken to prevent any addition of moisture. In areas with consistently high humidity (greater than 60 percent relative humidity), dry garlic may absorb moisture from the air if not stored correctly. Fully dried sliced or whole garlic will snap when bent, and fully dried chopped garlic pieces will not stick to each other or to the container.

Acidified Garlic in Oil

Commercial garlic in oil products are prepared following strict guidelines and must contain citric or phosphoric acid to increase the acidity. Acidifying whole garlic in vinegar is a lengthy and highly variable process; a whole clove of garlic covered with vinegar can take from 3 days to more than 1 week to sufficiently acidify. For this reason there are no guidelines for adequately acidifying whole garlic cloves in the home. As an alternative, follow the method below.

The University of Idaho Extension Service, in 2014, published research on acidification of chopped garlic, which makes it possible to acidify garlic in the home for safe use in oil mixtures (fig. 2). Infused oils made with acidified garlic retain quality better when refrigerated or frozen, and they can be safely stored at room temperature.

Citric acid powder is used in this recipe because it imparts less flavor to the garlic than either lemon juice or vinegar. Neither lemon juice nor vinegar were tested for acidifying garlic and should not be substituted here. Citric acid powder can be found at retail stores that sell canning supplies and often at grocery stores, health food stores, and pharmacies.

The research described a soaking ratio of 1 part garlic to 3 parts of 3% citric acid solution by weight (table 1). Using a kitchen scale is recommended, as it is a more precise way to measure the chopped garlic.

Example Recipe Using Amounts by Volume

Ingredients

2 cups warm water

1 tablespoon (15 ml or 15 g) citric acid powder

About 8 oz (250 g) peeled garlic cloves (approximately 2 to 3 medium heads of garlic)

Preparation

1. Wash your hands, utensils, and work surfaces, and then prepare the ingredients.
2. Combine warm water and citric acid powder in a mixing bowl. Stir gently until the citric acid crystals are completely dissolved. Set aside.
3. Coarsely chop the peeled garlic into pieces no larger than ¼ inch (6 mm) in any direction.

Table 1. Acidifying garlic for use in making flavored oils

Measuring method	Amount	
	Garlic	3% citric acid*
by weight using a scale	1 part	3 parts
	4 oz	12 oz
	100 g	300 g
by volume using measuring cups	⅔ cup	2 cups
	150 ml	450 ml

Source: Adapted from Abo et al. 2014.
Note: *3% citric acid = 1 tablespoon citric acid to 2 cups warm water (15 g citric acid to 500 g warm water).

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4. Measure exactly ⅔ cup (150 ml) of the chopped garlic; do not pack firmly. Add the chopped garlic to the 2 cups (500 ml) of prepared acid solution and stir gently. Cover and hold at room temperature for 24 hours to allow garlic pieces to become fully acidified.

   Note: In this recipe the soaking ratio (by volume) of ⅔ cup (150 ml) chopped garlic to 2 cups (500 ml) citric acid solution is critical—do not alter this ratio.

5. After 24 hours, pour the garlic mixture into a clean colander or sieve and drain well.
6. Add the acidified garlic to an oil of your choice. The recommended ratio for best flavor is 1 part acidified garlic to 10 parts of oil (by weight), but it is safe to increase or decrease this ratio to suit personal tastes.
7. Infuse the garlic–oil mixture for 1 to 10 days at room temperature. The flavor will intensify over time, and the length of the infusion will be based on personal preference. When the desired flavor has been reached the garlic can be removed. Removal of the garlic is not necessary for safety.
8. Store at room temperature or in the refrigerator or freezer. Oil quality will deteriorate faster if the product is stored at room temperature.

Roasting Garlic

Roasted garlic is sweet to the taste—delicious as a flavoring ingredient, a vegetable side dish, or on bread or crackers as an appetizer. To prepare roasted garlic, leave the head whole and cut off the tip of the head, exposing the cloves. Place the head(s) in a baking dish or on aluminum foil, sprinkle with olive oil or pat with butter, and season with salt and pepper and fresh or dried thyme, if desired. Cover dish (or seal foil) and bake at 350°F (180°C) until very soft (about 45 minutes to 1 hour). The roasted cloves can be easily squeezed from their skins and spread with a knife.

Frequently Asked Questions

Why Did My Garlic Turn Blue?

Figure 3. Acidified garlic cloves showing the blue pigment that can sometimes occur. *Photo:* Sheryl Yamamoto

Garlic contains anthocyanins, water-soluble pigments that can turn blue or purple in acidic environments like vinegar or pickling brine (fig. 3)—the garlic is still safe to eat. This color change is a variable phenomenon that is more likely to occur with immature garlic, but it can differ among cloves from a single head of garlic. If you grow your own garlic, be sure to cure it at room temperature for a couple of weeks before using it.

What Are Some Garlic Equivalents?

You can substitute ⅛ teaspoon garlic powder or ¼ teaspoon dried garlic for each 1 medium clove garlic called for in recipes.

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