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Olives: Safe Methods for Home Pickling

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WHAT ARE OLIVES?

The olive tree, *Olea europaea*, valued for both its beauty and its fruit, has been a part of Mediterranean civilization since before recorded history. The olive was cultivated and its oil traded as early as 3000 B.C.E. Olives and olive oil have been used for food, cooking, medicine, salve, soap, and lamp fuel.

Today, most of the world's olives are still grown in the Mediterranean region. The olive tree is best suited to areas with a Mediterranean climate—a long, hot growing season and a relatively cool winter. Most commercial olive acreage in the United States is in California, with growth concentrated in the interior valleys of Central California.

Five commercially important olive varieties are grown in California: Manzanillo, the most common variety; Mission, which was originally cultivated by Franciscan monks; and Sevillano, Ascolano, and Barouni, which have very large fruit. Over 80 percent of California's olives are used in the production of canned black ripe style or California black ripe style olives; the remaining crop is crushed for olive oil or processed into specialty styles of olives. Many other popular table and oil olive varieties, including Kalamata, Hojiblanca, and Picholine, are grown on a smaller scale in orchards and home gardens throughout California.

NUTRITION

Olives and olive oil are good sources of monounsaturated fat. Olive oil has the highest percentage (over 70%) of monounsaturated fat of any edible oil. Olives and olive oil also contain other minor components such as pigments, flavonoids, and phenolic compounds that act as antioxidants and may offer protective health benefits.

SELECTING FRESH OLIVES

Select only freshly harvested, unbruised olives for processing at home. Olives are harvested at different stages of ripeness ([fig. 1](#))—*green-ripe*, *turning color*, and *naturally black ripe*. The first mature *green-ripe* olives are ready to be picked in California starting in mid-September, when the fruit have reached their full size. Mature green-ripe olives will release a characteristic creamy white juice when you squeeze them. Most green-ripe olives are harvested when they are *even colored*, from yellow-green to a straw color. As the olives ripen further, their color turns from yellow-green to rose to red-brown. These *turning color* olives are still firm and their flesh lacks dark pigment or is partially pigmented close to the skin. *Naturally black ripe* olives are allowed to ripen fully on the tree. They reach the desired dark red to purple or black stage of color about 3 to 4 months after the green-ripe stage.



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Figure 1. Freshly harvested olives at different stages of ripeness: green-ripe (1 and 2); yellow-green to straw (3); rose to red-brown (4 and 5); and red-brown (6) (may be too soft for some types of olive curing). Not shown are naturally black ripe olives (also described as dark red to purplish black).

Naturally black ripe olives are harvested in California starting in mid-November and continuing through December, depending on the variety, crop yield, and region, and on weather conditions. When mature, these olives will release a reddish black liquid when you squeeze them and their flesh will be nearly completely pigmented. Ripe olives bruise easily and must be handled with care.

The oil content of olives increases during ripening. Naturally black ripe olives are primarily used for oil extraction. Black olives with pigment through to the stone are considered overripe and will be softer when processed, but are the preferred fruit for some types of dried olives. Olives with varying maturity will usually need to be sorted according to ripeness before you begin any of the processing methods described in this publication.

Some olive varieties are preferred for specific olive styles, based on their flavor, texture, size, and processing characteristics. For example, the Manzanillo variety is ideal for lye-cured olives and Spanish-style green olives, the Mission variety is excellent for dry salt cured ripe olives and dark ripe style or California black ripe style olives, the Kalamata variety is ideal for Kalamata-style water-cured olives, and the Sevillano variety is often used for Sicilian-style fermented olives.

STORING FRESH OLIVES

Fresh olives, especially naturally black ripe olives, should be processed within a few days after harvest if possible. Green-ripe olives generally store better than naturally black ripe olives. For best quality, store olives at temperatures between 41° and 50°F, preferably in shallow, ventilated crates. Storage of fresh olives at colder temperatures (from 32° to 36°F) for 2 weeks or more can cause chill injury that will lead to internal browning and skin browning. Chill injury shouldn't be a problem if the olives are exposed to these colder temperatures for only short periods of time. Sevillano olives are most susceptible to chill injury, followed by Ascolano, Manzanillo, and Mission (least susceptible). Prolonged (6 weeks or more) storage of fresh olives at 50°F can cause surface pitting and spotting.

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METHODS FOR CURING OLIVES

Olives picked off the tree contain a very bitter compound called *oleuropein*. Harvested olives must be “cured” to remove the bitterness in order to make them palatable. The most common curing processes use brine, dry salt, water, or lye treatments. During these curing processes the water-soluble oleuropein compound is leached out of the olive flesh.

The flavor and texture of each style of olive depends partly on the curing process used. Lye-curing is the most rapid and efficient process for de-bittering, but many people think that lye-cured olives are less flavorful than other styles of olives. Brined olives undergo a natural fermentation not unlike that used for traditional dill pickles and sauerkraut. Acids produced in the fermentation process by lactic acid bacteria that are naturally present on the fruit give these olives a distinctive flavor and aroma. Brined olives tend to be saltier than lye-cured olives. Water curing does not change the flavor of the olives as much as other curing methods. This publication includes directions for making water-cured, brine-cured, dry salt cured, and lye-cured olives.

The storage life of the olives that you prepare at home varies depending on the olive style, and is indicated in the instructions. For a longer storage life you can preserve some olives using additional methods (e.g., freezing, drying, pressure canning)—see [table 1](#) for suitable preservation methods for the olive styles included in this publication.

CAUTION: If at any time the olives become moldy or soft or bad smelling, do not eat them or taste them. (See precautions under “Disposal of Spoiled and Questionable Olives.”)

WATER-CURED OLIVES

To prepare olives for water curing, you must first individually cut or crack each olive so that the bitter oleuropein can more easily leach out. The prepared olives are soaked in water and the water is changed daily over a week or more, depending on the olive style and the desired level of bitterness. After curing, the olives are placed in a *finish brine*, which is a vinegar-salt solution that adds the characteristic flavors. The advantage of this method is that the olives are ready to eat within a few weeks. These olives will still be slightly bitter because water curing removes less oleuropein than other methods.

Table 1. Suitable preservation methods for home-prepared olives

Olive style	Suitable preservation methods				
	Brine	Refrigeration	Freezing*	Drying	Pressure canning
Water-cured					
Kalamata-style olives	✓	✓			
Mediterranean-style cracked olives	✓	✓			
Brine-cured					
Greek-style black olives in brine	✓	✓			
Sicilian-style green olives in brine	✓	✓			
Dry salt cured					
		✓	✓		
Lye-cured					
Green olives	✓	✓	✓	✓	✓
Dark ripe style olives	✓	✓	✓	✓	✓
Lye-cured fermented					
Spanish-style green olives	✓	✓			✓

* Freezing is most suitable for smaller olive varieties with higher oil content (e.g., Mission, Kalamata, and Picholine); larger varieties (e.g., Sevillano, Ascolano, and Barouni) will soften during freezing.

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Instructions for two styles of water-cured olives are included here. **Kalamata-style olives** are made with naturally black ripe olives that are cut before they are soaked in water. **Mediterranean-style cracked olives** are made with green-ripe olives that are cracked before soaking.

Use pickling salt. We recommend that you use pickling salt (also known as *canning salt* or *pure salt with no additives* or *sodium chloride*) for making brines and for salting olives. The anti-caking agents added to regular table salt will turn the brine cloudy. The quantities of salt used in the following recipes are based on fine-grained pickling salt that is commonly available in the United States. Quantities are given in weight (ounces or pounds) and also in volume (cups)—an equivalent quantity of table salt can be substituted if pickling salt is not available. If you use other types of salt, such as coarse salt or kosher salt (which can vary greatly in density), measure it by weight to make sure you have the equivalent quantity. Do NOT use sodium-reduced “salt substitutes.”

Kalamata-style olives

Use ripe, fully colored (dark-red to purplish black) fruit to prepare this style of olive. Make sure the olives are firm and were harvested before the first frost. Use an oil-rich olive variety such as Kalamata or Mission. Do not use Sevillano olives: they will become too soft.

Supplies needed

- Mature, fully colored (dark red to purplish black) olives
- Pickling salt
- Red wine vinegar
- Olive oil
- Airtight, food-grade plastic, or glass containers (for olives)
- 1-gallon container (for mixing brine)

Preparation

1. Sort the olives according to size, if desired, and discard any bruised or defective fruit.
2. Rinse olives in water, and drain.
3. With a clean, sharp knife make 2 lengthwise cuts on each olive, slicing about $\frac{1}{8}$ inch into the olive flesh.
4. Place the cut olives into a food-grade plastic pail (or other container as listed above) and cover olives with fresh, cool water. Keep the olives submerged by placing a heavy plate or a sealed plastic food-storage bag filled with water over the fruit. Close the container lid loosely and leave the olives to soak.
5. After 24 hours, drain the olives and cover again with fresh, cool water. Repeat the water change daily for 8 to 10 days to reach the desired level of de-bittering. If you want less-bitter olives, continue to soak for up to 20 days and change water daily. Monitor carefully: over-soaking will lead to soft olives with a washed-out taste.
6. Prepare the finish brine: add 1 pound ($1\frac{1}{2}$ cups) of pickling salt to 1 gallon of cool water, stir to dissolve, and add 1 quart (4 cups) of red wine vinegar. This amount of solution is enough to treat about 10 pounds of fresh olives.
7. Drain the de-bittered olives, cover with the finish brine, and pour $\frac{1}{4}$ to $\frac{3}{8}$ inch of olive oil on top. Close the container lid firmly and store at about 60° to 80°F.
8. Allow the olives to marinate in this vinegar-salt solution for about 1 month to develop the desired flavor.
9. These Kalamata-style water-cured olives can be stored in the finish brine in a cool, dark place or refrigerated for about 1 year if the container remains airtight.

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Mediterranean-style cracked olives

Use green-ripe fruit of any variety to prepare this style of olive. After these olives are cured and placed in the finish brine, you can also add a variety of seasonings, such as oregano, garlic, and lemon slices, to provide additional flavor.

Supplies needed

- Green-ripe olives
- Pickling salt
- White wine vinegar
- Herbs, garlic, lemon, or other seasonings (optional)
- Airtight, food-grade plastic, or glass containers (for olives)
- 1-gallon container (for mixing brine)

Preparation

1. Sort the olives according to size, if desired, and discard any bruised or defective fruit.
2. Rinse the olives in water, and drain.
3. Place olives one or two at a time on a clean cutting board and strike with the flat side of a mallet or with a rolling pin. Crush each olive just to crack the flesh—do not break the pits or remove them.
4. Place the cracked olives into a food-grade plastic pail (or other container as listed above) and cover olives with fresh, cool water. Keep the olives submerged by placing a heavy plate or a sealed plastic food-storage bag filled with water over the fruit. Close the container lid loosely and leave the olives to soak.
5. After 24 hours, drain the olives and cover again with fresh, cool water. Repeat the water change daily for 6 to 7 days to reach the desired level of de-bittering. If you want less-bitter olives, continue to soak for a few more days and change water daily.
6. Prepare the finish brine—add 1 pound (1½ cups) of pickling salt to 1 gallon of cool water, stir to dissolve, and add 2 cups of white wine vinegar. This amount of solution is enough to treat about 10 pounds of fresh olives.
7. Drain the de-bittered olives and cover with the finish brine. At this point you can add herbs or other seasonings if desired, such as chopped oregano, lemon slices, and garlic cloves. Close the container lid firmly and refrigerate. *Note: These olives must be kept refrigerated.* The olives are ready to eat after 4 days in the finish brine or you can allow the flavors to develop more fully during longer refrigerated storage.
8. These Mediterranean-style cracked olives can be stored *in the refrigerator* for up to 1 year in the finish brine.

BRINE-CURED OLIVES

Olives can be cured by placing them directly into *brine* (a concentrated salt solution) where they undergo a natural fermentation. The olives develop a unique flavor during

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the fermentation when sugars in the fruit are converted to lactic and acetic acids. The fermentation also breaks down the chemical bond between oleuropein and sugars in the olive, allowing this bitter compound to be leached into the brine. Brine curing is simple and requires only water and salt for the initial washing and fermentation. However, the process takes at least 3 months and may take 6 months or longer, depending on the fruit variety and maturity as well as the temperature, salt concentration, and acidity (pH level) of the brine.

Green-ripe olives take longer to cure in brine than naturally black ripe olives. Instructions for two styles of brine-cured olives are included here. **Greek-style black olives in brine** are made with mature olives cured in strong brine over several months to reduce the bitterness. **Sicilian-style green olives in brine** are made with green-ripe olives that are cured in a batch of seasoned brine for 4 to 6 months. The salt is one of the preservatives for these olives, helping to reduce chances of spoilage and to ensure a consistent fermentation, so do not alter the brine concentrations given in the instructions below. You can safely store both styles of olive in brine for 1 year.

Greek-style black olives in brine

Always use mature, fully colored (dark red to purplish black) fruit to prepare this style of olive. Make sure the fruit is firm and was harvested before the first frost. You can use any olive variety, but Manzanillo, Mission, or Kalamata are most common for this method. Some of the olives' coloring may fade during curing but they tend to darken again when exposed to air. The cured olives may become slightly shriveled because of the high salt concentration of the brine used to preserve them. The finished product will have some fruity and bitter flavors.

Supplies needed

- Mature, fully colored (dark red to purplish black) olives
- Pickling salt
- Airtight, food-grade plastic or glass containers (for olives)
- 1-gallon container (for mixing brine)

Preparation

1. Sort the olives according to size, if desired—a batch of olives will cure more evenly if the fruit are similar in size. Discard any bruised or defective fruit.
2. Pack the sorted olives into containers that can be made airtight—a 1-quart glass jar is the smallest size recommended.
3. Prepare medium brine with 8 ounces ($\frac{3}{4}$ cup) of pickling salt per gallon of cool water.
4. Cover the olives with brine and close lids loosely. Store the filled containers at about 60° to 80°F.
5. After 7 days, replace brine with a fresh batch of strong brine made with 1 pound ($1\frac{1}{2}$ cups) of pickling salt per gallon of water. Close the lids firmly. Store the olives in brine for at least 2 months. If you prefer less-bitter olives, replace the brine with a fresh batch of strong brine at 1-month intervals for 2 or 3 months. Changing the brine more often will leach out more of the bitter oleuropein.

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6. Check the containers at regular intervals. If gas pressure builds up during fermentation and causes the lids to bulge, carefully loosen the bulging lids to release the gas, and then firmly close them again. The gas is naturally produced by the bacteria that are responsible for the fermentation. If brine leaks out, replace it with fresh strong brine made with 1 pound (1½ cups) of pickling salt per 1 gallon of water.
7. If you like fairly bitter olives you can eat these olives (or use them for cooking) after 2 months of storage. If you prefer less-bitter olives, store the olives for at least 3 months before eating.
8. These Greek-style black olives can be stored in the strong brine in a cool, dark place for at least 1 year if the jars remain airtight (to minimize surface yeast and mold growth) and the lids do not corrode.
9. To avoid mold growth on the surface after opening an olive container, refrigerate any uneaten olives. To reduce saltiness, you can soak the olives in water overnight before eating them out-of-hand. After this soaking you can also place the olives in a little olive oil. The olive oil may congeal in the refrigerator, so before serving allow the olives to sit at room temperature until the oil has liquefied.

Sicilian-style olives

Sicilian-style olives are similar to the common Spanish-style cocktail olives but are somewhat more bitter because they are only fermented in brine that has been seasoned with various herbs and spices. Commercially prepared cocktail olives are also cured with lye, which removes more of the bitterness. Use green-ripe olives of any variety, although Sevillano is most commonly used. With Sevillano, discard any olives with color (rose or red-brown): they will soften and will not hold up to the curing process.

Supplies needed

- Green-ripe olives (usually Sevillano)
- Dill pickle spices or desired seasonings
- Pickling salt
- Vinegar (5% acetic acid)
- Airtight, food-grade plastic or glass containers (for olives)
- 1-gallon container (for brine)

Preparation

1. Sort the olives according to size, if desired, and discard any bruised or defective fruit.
2. Pack the olives into quart or half-gallon glass jars that can be made airtight, or place larger amounts in food-grade plastic pails or barrels with tight fitting lids.
3. To each container add seasonings as desired. You may want to add dill pickle spices—use about 1 level tablespoon per quart jar or 1 rounded tablespoon per 2-quart jar. You may also try adding a little fennel seed (½ teaspoon per quart) or a sprig of fresh fennel or dill, as well as chopped garlic. Or you may prefer to make a “hot” seasoning by adding whole peppercorns and whole dried chili peppers, as desired.

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4. Prepare brine. The amount of salt to use depends on the size of the olives. For large olives (e.g., Sevillano and Ascolano varieties), which shrivel easily in a strong salt brine, prepare a medium-strong brine with 10 ounces (1 cup) of pickling salt per gallon of cool water. For small olives (e.g., Manzanillo and Mission varieties), which do not shrivel easily in salt brines, prepare a strong brine with 1 pound (1½ cups) of pickling salt per gallon of cool water.
5. Add about 2 cups of vinegar to each gallon of brine. Cover the olives in the jars or barrel with the brine-vinegar mixture and loosely close the lids.
6. Store the olives in brine at about 70°F for about 2 months, checking the containers at regular intervals. Fermentation will be most rapid at temperatures between 70° and 90°F. During the initial period of active fermentation (4 or 5 days), when a large amount of gas forms and excessive foaming and frothing occur, take care to replace any lost brine. Keep the containers full of brine at all times. Replacement brine should be made with 10 ounces (1 cup) of pickling salt plus 1⅔ cups of vinegar per gallon of water.
7. When gas bubbles stop forming (within 2 months), tighten container lids firmly and store for at least another 2 to 4 months or until the olives develop the flavor you desire.
8. These Sicilian-style green olives can be stored in a cool, dark place for at least 1 year in brine when properly fermented, if the jars remain airtight (to minimize surface yeast and mold growth) and the lids do not corrode.

DRY SALT-CURED OLIVES

Prepare dry salt cured olives from fully ripe, mature fruit that is dark red to black. Oil-rich varieties such as Mission are commonly used, but other varieties will also work. Use smaller olives; larger ones will soften too much during the process. Salting dehydrates the olive flesh, resulting in a soft, moist, shriveled product. Dry salt cured olives will be ready to eat about 5 to 6 weeks after you begin the salting process. These olives are salty and also slightly bitter because dry salt curing removes less oleuropein than other methods.

Dry salt cured olives can be stored for up to 6 months in a refrigerator, as described below, or they can be frozen for longer storage (see *Methods for Preserving Cured Olives*).

Supplies needed

- Mature, fully colored (dark red to purplish black) olives
- Pickling salt
- Slat wood box, wicker or plastic basket, or plastic bin (for olives)
- Cheesecloth or nylon mesh
- Airtight, food-grade plastic or glass containers (to store olives)

Preparation

1. Sort the olives and discard any bruised or defective fruit.
2. Prepare a large container that will hold the olives and salt. Use a slat wood box, a large wicker basket (it will likely stain), or a plastic bin with some drainage holes

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cut into the bottom. Line the bottom of the container with clean cheesecloth or nylon mesh. **NOTE:** Place the container outdoors (under cover) or over a large pan so the draining brine will not ruin your floors. Raise the container on small blocks to improve air circulation around the bottom.

3. Weigh the sorted olives and place them into the container. Add about 1 pound (1½ cups) of pickling salt for every 2 pounds of olives. Mix the salt and olives very thoroughly in the container to distribute the salt and prevent mold from developing. Pour a 1-inch layer of additional pickling salt over the olives. Cover the container with clean cheesecloth and let it stand at about 60° to 80°F.
4. After 1 week, re-mix the salted olives by pouring them into a clean pail and then back into the first container. Add a small layer of salt over the top of the olives. Cover the container with a clean cloth and let it stand.
5. Repeat the mixing process once a week for the next month, until the olives are cured and edible.
6. When the olives are ready, pour them over a coarse screen to sift out any remaining salt. Allow the olives to dry overnight at room temperature.
7. Before storing the olives, add 1 pound (1½ cups) of pickling salt to each 10 pounds of cured olives. Mix the olives and salt thoroughly and pack them into airtight containers (to minimize surface yeast and mold growth). Store in a cool place and use within 1 month, or refrigerate for up to 6 months, or store in a home freezer for up to a year. (Olives tend to become rancid if stored longer.) You can use these olives, as is, for cooking. For eating out-of-hand, you can first dip the olives briefly into boiling water to remove salt, allow them to air dry, and then rub them with a little olive oil and add herbs, such as rosemary, before serving.

USING LYE SAFELY

Lye, also known as sodium hydroxide or caustic soda, is a multipurpose chemical that is commonly used in making soap, peeling some types of peaches, and in preparing some foods, such as Scandinavian lutefisk, hominy, and olives.

Lye will react with some metals, so it is important to use only certain materials when working with lye in the home. Safe materials for containers and utensils include stainless steel, cast iron, enamelware, glass, heatproof stoneware, wooden barrels, and household plastics that are intended for food use. It is best to use light-colored containers, as dark colors may leach color. When using a dark-colored container, first soak it for a few days in a lye solution made by adding 2 ounces of lye (4 level tablespoons of flake lye or 3 level tablespoons of granular lye) to 1 gallon of water. **Always add the lye to the water, not water to the lye.** Rinse the container thoroughly before use.

CAUTION: Never use aluminum, tin, lead, or zinc galvanized metals with lye: lye will corrode and ruin containers or utensils made of these metals, and the reaction will give off hydrogen gas. Lye also dissolves the zinc in galvanized coatings, which may make olives in such containers poisonous.

Sources of lye

The lye used to cure olives must be 100 percent (%) pure sodium hydroxide (NaOH), also known as caustic soda or lye. Pure lye is available in some hardware stores (try the plumbing section) and farm supply stores. You can also order pure lye from some soap making, chemical, or hobby suppliers. Because lye is a reactive chemical it is shipped in small quantities and often only by surface transportation. You can search the internet for “lye sources” in your area, or search under “soap making supplies,” “chemistry supplies sodium hydroxide,” or “sodium hydroxide.”

Lye suppliers

Supplier information can become outdated very quickly, so we have not included specific supplier names in this publication. Contact your County University of California Cooperative Extension office for an updated list or search online or in the yellow pages for the types of local suppliers mentioned above.

Using lye

Pure lye is available in flake or granular form (beads or pellets). You can use either type of lye, but note that an ounce (by weight) of flake lye has a greater volume than an ounce of granular lye. Use an accurate scale to weigh the lye, if possible. Weight measurements are provided in all recipes in this brochure, along with approximate volume measurements for flake and granular lye.

To make a lye solution, add the lye carefully to cold water (*never* add water to lye) and stir the solution until the lye is completely dissolved. When you add lye to water, heat is generated. You must cool the lye solution down to 65° to 70°F before using it with olives—hotter lye solutions will soften

CAUTION: Lye must always be handled very carefully since it is an extremely corrosive and a highly reactive chemical. Lye can cause severe burns, permanent injury, or scarring if it comes into contact with your skin or eyes. Always wear eye protection (safety goggles) and intact rubber gloves when working with lye. Wear closed-toed shoes, long pants, and a shirt with long sleeves. A face shield, rubber apron, and rubber boots are also highly recommended. (Also see *First Aid for Lye Contact*, below.)

CAUTION: Many people used to use a product called Red Devil (a 100% lye drain cleaner) as a source of household lye, but this product is no longer being manufactured. Do not substitute other types of drain cleaners unless the label clearly states that the product is “100% lye.”

and discolor the olives. Use a thermometer to accurately measure the temperature of lye solutions.

Always store lye in an airtight, moisture-resistant container and keep it safely away from children and pets.

NOTE: 2 ounces (by weight) of lye = 4 level tablespoons of flake lye OR 3 level tablespoons of granular lye.

Disposal of lye solutions

Plan your lye disposal before you start preparing any lye-cured olives. If possible, set up your olive production area close to a household drain (e.g., a laundry sink or a spare bathtub) so that you will not have to carry pails of this corrosive solution through your house. Carefully pour used lye solution and any rinse water containing traces of lye down a household drain so that the solution enters your community's water treatment system. Flush the drain well with additional water to remove all traces of lye. Do NOT pour lye solutions into storm sewer drains on the street.

First Aid for Lye Contact

For lye on the skin:

- Take off any clothing touched by the lye.
- Rinse the skin with large amounts of lukewarm water for at least 15 minutes.
- Call Poison Control*.

For lye in the eye:

- Rinse the eye with lukewarm water for at least 15 minutes.
- Call Poison Control*.

For swallowed lye:

- Give small SIPS of water or milk immediately.
- Call Poison Control*.
- Do NOT try to make the person throw up (vomit).
- If the person is unconscious, convulsing, or having a hard time breathing or swallowing, call 911 immediately.

* Check the front of your local telephone book for the number of Poison Control or the Poison Information Center in your region.

Write the number here for reference: _____

CAUTION: Before making lye-cured olives, be sure to thoroughly read and understand the accompanying section, *Using Lye Safely*. Lye is extremely corrosive to the skin. Always wear intact rubber gloves and eye protection. Use the correct utensils when working with lye—do not use aluminum, tin, or galvanized metal.

Test for lye penetration:

To test how far the lye has penetrated the olives during a curing process, carefully remove several olives from the lye solution (using a plastic, wooden, or stainless steel spoon) and rinse under plenty of running water. Cut sample olives to the pit with a sharp knife. If you are curing different-sized olives, test the largest fruits for lye penetration. The lye solution discolors the flesh to a yellowish green color. Olives that are completely penetrated will have uniformly yellowish green flesh from the skin to the pit. If the lye has not penetrated completely, you will see milky white flesh surrounding the pit and extending out to where it meets the lye-discolored flesh.

LYE-CURED OLIVES

Olives can be rapidly cured by placing them in a lye (sodium hydroxide) solution. The lye breaks the chemical bond between oleuropein (bitterness compound) and sugars in the olives. After curing is complete, you remove all traces of lye with a series of cold water rinses and then pack the olives in brine. The rinsing process also removes the bitterness, leaving a neutral, somewhat “buttery” flavored olive that can accept flavors from vinegar and herbs in the brine. There is no fermentation step in this method. Lye-cured olives have a firm texture and a smooth, mild taste.

Instructions for two styles of lye-cured olives are included here—**Green olives** and **Dark ripe style olives**. Both styles are made using green-ripe fruit. The rich brown-black color of the dark ripe style olives develops when you deliberately expose the fruit to air during the lye-curing process. Natural phenolic compounds in the olives react with oxygen to create the black color.

Before you start to prepare these lye-cured olives, familiarize yourself with the color of the fresh olive flesh so that you can later recognize the color change that occurs due to lye penetration (see *Test for lye penetration*). Take a few representative olives and cut out a quarter section from the skin to the pit of each olive. In a green olive, the flesh color will probably be quite white; if the olive is reddish brown on the outside, the flesh inside may have some color.

Lye-cured olives can be stored for up to 2 months in brine, as described below, or they can be preserved for longer storage by freezing, drying, or pressure canning (see *Methods for Preserving Cured Olives*).

Green ripe olives

Choose green, straw-colored, or slightly red fruit—it is best to use olives that are similar in color (same degree of ripeness) and size for even curing. This process will produce straw-yellow to green-brown olives that are ready to eat within about 2 weeks after the start of the lye treatment.

Supplies needed

- Green, straw-colored, or slightly red olives
- Protective equipment (rubber gloves, goggles, etc.—see *Using Lye Safely*)
- Lye (100% pure)
- Lye-resistant container and utensils (to measure, mix, and hold lye solution)
- Lye-resistant containers (to hold curing olives)
- Cheesecloth or nylon mesh
- Pickling salt
- 1-gallon container (for mixing brine)
- Airtight, food-grade plastic or glass containers (to hold olives in brine)

Preparation

1. Sort the olives according to size, if desired. If olives in each treatment batch are similar in size and color, the lye can penetrate all of the olives in that batch at a more even rate. Discard any bruised, defective, or black ripe fruit.

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2. Place the sorted olives into a lye-resistant container. Use a separate container for each size of fruit.
3. Prepare a lye solution by carefully adding 2 ounces of lye (4 level tablespoons of flake lye or 3 level tablespoons of granular lye) to every gallon of cold water. The solution will heat up during mixing. **Always add the lye to the water, not water to the lye.** Cool the solution to 65° to 70°F before use.
4. Cover the olives with the cooled lye solution—you will need to check these olives regularly over the next 12 hours, so keep this in mind before you start the lye treatment. Place a cloth or nylon mesh over the olives and weigh down firmly with a heavy plate to keep the olives submerged. To keep the olives from darkening you must avoid exposing the fruit to the air during the lye treatment.
5. Stir the olives every 2 hours until the lye reaches the pits—this usually takes 10 to 12 hours. At intervals of 1 to 2 hours do the test for lye penetration as described in the sidebar. When lye penetration is complete, proceed to Step 7; if lye does not penetrate completely within 12 hours, go to Step 6.
6. If the lye has not reached the pits after 12 hours, carefully drain off the lye solution. Cover the olives with a cool, fresh lye solution of 1 ounce of lye (2 level tablespoons of flake lye or 1 level tablespoon plus 1 level teaspoon of granular lye) per gallon of water. Let stand until lye penetration is complete. This may take as long as 30 hours if the fruit is very green. NOTE: Sometimes this second lye treatment is insufficient because some olives neutralize most of the lye before it can penetrate to the pits. In this case you must drain the olives again and cover them with a cool, fresh lye solution of 1½ ounces of lye (3 level tablespoons of flake lye or 2 level tablespoons of granular lye) per gallon of water. Let the olives stand until the solution reaches the pits as determined by the test for lye penetration. Then proceed with Step 7.
7. Drain off the final lye solution, rinse the olives twice in cold water, and then cover them with fresh, cold water and let stand.
8. For the next few days, change the water at least two times each day to “wash” the olives (to remove the lye). Work quickly to drain and cover olives with fresh water so that you limit their exposure to air. This will help keep the fruit from darkening. After 2 to 3 days, begin to taste the olives regularly until you can no longer taste the lye (lye tastes soapy). This washing step may take as long as 7 or 8 days, depending on the size of the olives, the frequency of rinsing, and the volume of water you use. The color of the rinse water will gradually change with each “wash”—going from an olive green color to a lighter yellow to a pink and then to clear water. When washing is complete, drain the water from the olives. These olives must then be brined: for short-term storage, proceed with Step 9; for longer storage, follow instructions in Step 10.
9. *For short-term storage (2 weeks):* Prepare a light brine containing 4 ounces (6 level tablespoons) of pickling salt per gallon of water. Cover the olives with the brine and let stand for 2 days. (If the brine turns slightly pink when you add it to the rinsed olives, some lye is still present. Repeat Step 8 and wash until all lye is removed.) After standing in brine for 2 days, the olives are ready for use. They can be stored in a refrigerator for up to 2 weeks in a tightly covered container.

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10. *For longer storage (2 months)*: Prepare a medium brine using 8 ounces ($\frac{3}{4}$ cup) of pickling salt per gallon of water. Store the olives in this brine for 1 week. Drain and replace with a strong brine made with 1 pound ($1\frac{1}{2}$ cups) of pickling salt per gallon of water. After 10 to 12 days, drain and replace again with fresh brine made with 1 pound ($1\frac{1}{2}$ cups) of pickling salt per gallon of water. It is important, especially with larger olives, that you gradually increase the brine strength as described here to limit shriveling of the olives. These brined olives can be stored in a refrigerator for up to 2 months in a tightly covered container. Before you eat them, soak a portion of these olives overnight in water to remove excess salt. Then use the olives within 3 days.

Dark ripe style olives

Choose green, straw-colored, or red fruit—it is best to use olives that are similar in color (same degree of ripeness) and size for even curing. The curing process for this olive style is more complex than for the green olive style. There are five separate lye treatments and you expose the olives to air after each treatment to allow the brown-black color to develop. These olives are similar to California black ripe style olives and are ready to eat about 2 weeks after you start the lye treatments.

Supplies needed

- Green, straw-colored, or slightly red olives
- Protective equipment (rubber gloves, goggles, etc.—see *Using Lye Safely*)
- Lye (100% pure)
- Lye-resistant container and utensils (to measure, mix, and hold lye solution)
- Lye-resistant containers (to hold curing olives)
- Cheesecloth or nylon mesh
- Pickling salt
- 1-gallon container (for mixing brine)
- Airtight, food-grade plastic or glass containers (to hold olives in brine)

Preparation

1. Sort the olives according to size, if desired. If olives in each treatment batch are similar in size, the lye can penetrate all of the olives at a more even rate. Discard any bruised, defective, or black ripe fruit.
2. Place the olives into a lye-resistant container. Use a separate container for each size of fruit.
3. *First lye treatment*: Prepare a lye solution by carefully adding $1\frac{1}{2}$ ounces of lye (3 level tablespoons of flake lye or 2 level tablespoons of granular lye) to every gallon of cold water. The solution will heat up during mixing. **Always add the lye to the water, not water to the lye.** Cool the solution to 65° to 70°F before use. Pour the cooled lye solution over the olives to cover them completely and let stand until the solution just penetrates the skins. Start checking the olives after 3 hours as described in the *Test for lye penetration*; continue to check every 30 minutes until you detect lye-discolored olive flesh just beneath the skin. Pour off the lye solution and expose the olives to the air for 1 day—simply leave the olives in the same container and stir them gently at three evenly spaced intervals during the day.

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4. *Second lye treatment:* Prepare fresh lye solution, as above. Pour the solution over the olives and let stand until it penetrates $\frac{1}{32}$ to $\frac{1}{16}$ inch into the flesh. Pour off the solution and expose the olives to the air for 1 day as described in Step 3.
5. *Third lye treatment:* Prepare fresh lye solution as above. Pour the solution over the olives and let stand until it penetrates $\frac{1}{8}$ to $\frac{3}{16}$ inch into the flesh. Pour off the solution and expose the olives to the air for 1 day as described in Step 3.
6. *Fourth lye treatment:* Prepare fresh lye solution as above. Pour the solution over the olives and let stand until it penetrates $\frac{3}{16}$ to $\frac{5}{16}$ inch into the flesh. Pour off the solution and expose the olives to the air for 1 day as described in Step 3.
7. *Fifth lye treatment:* Make a slightly stronger fresh lye solution by adding 2 ounces of lye (4 level tablespoons of flake lye or 3 level tablespoons of granular lye) to every gallon of cold water. Cool to 65° to 70°F. Pour the solution over the olives and let stand until it penetrates completely to the pits. Pour off the solution and expose the olives to the air for 1 day as described in Step 3.
8. Cover the olives with cold water. Change the water two times daily to wash the olives (to remove lye). After 2 to 3 days, begin to taste the olives daily until you can no longer taste the lye (lye tastes soapy). This washing step may take as long as 7 or 8 days.
9. Drain the water, cover the olives with brine, and then let stand for 2 days before eating. Dark ripe style olives in light brine, made with 4 ounces (6 level tablespoons) of pickling salt per gallon of water, can be refrigerated for up to 2 weeks in a tightly covered container. For a longer shelf life, cover the olives with strong brine made with 1 pound (1½ cups) of pickling salt per gallon of water—in this solution, the olives can be refrigerated for up to 2 months in a tightly covered container. Before eating, remove the olives you plan to eat and soak them overnight in water to remove excess salt, and make sure to use them within 3 days.

LYE-CURED FERMENTED OLIVES

Olives can also be cured using an initial lye treatment and then fermented in brine for several months. Acids produced in the fermentation by lactic acid bacteria give these olives a distinctive flavor and aroma. These bacteria are naturally present on fresh olives but in concentrations that may not be high enough for a successful fermentation after the lye treatment. A starter culture of lactic acid bacteria is generally added to the treated olives to encourage the fermentation. The **Spanish-style green olive**, the popular cocktail olive, is lye-cured and fermented. Instructions are included here.

Lye-cured fermented olives can be stored for up to a year in brine, as described below, or can be preserved for longer storage by pressure canning (see *Methods for Preserving Cured Olives*).

Spanish-style green olives

Choose green to straw-colored fruit—it is best to use olives that are similar in color (same degree of ripeness) and size for even curing. Sevillano and Manzanillo varieties are excellent for this olive style, but you can use any variety. This process will produce green olives with light flesh and a light brownish buff pit. The olives will be ready to eat about 2 months after you start the lye treatment, but will be more flavorful if you allow them to ferment for up to 6 months in brine.

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CAUTION: Before making lye-cured olives, be sure to thoroughly read and understand the accompanying section, *Using Lye Safely*. Lye is extremely corrosive to the skin. Always wear intact rubber gloves and eye protection. Use the correct utensils when working with lye—do not use aluminum, tin, or galvanized metal.

Supplies needed

- Green or straw-colored olives
- Protective equipment (rubber gloves, goggles, etc.—see *Using Lye Safely*)
- Lye (100% pure)
- Lye-resistant container and utensils (to measure, mix, and hold lye solution)
- Lye-resistant containers (to hold curing olives)
- Cheesecloth or nylon mesh
- Pickling salt
- Lactic acid starter culture
- 1-gallon container (for mixing brine)
- Airtight, food-grade plastic or glass containers (to hold olives in brine)

Preparation

1. Sort the olives according to size, if desired. If olives in each treatment batch are similar in size then the lye can penetrate all of the olives at a more even rate. Discard any bruised, defective, or black ripe fruit. Any bruise marks will become highly visible on the pickled fruit.
2. For Sevillano olives, prepare a lye solution using 2 ounces of lye (4 level tablespoons of flake lye or 3 level tablespoons of granular lye) per gallon of cold water—this olive variety frequently blisters and peels if treated with a stronger solution. For Manzanillo and Mission olives, prepare a stronger lye solution using 2½ ounces of lye (5 level tablespoons of flake lye or 3½ level tablespoons of granular lye) per gallon of cold water—these olives are more bitter than other varieties but do not blister and peel as readily. The lye solution will heat up during mixing. Cool the solution to 65° to 70°F before you use it in Step 3.
3. Cover olives with the cooled lye solution. Place clean cheesecloth or nylon mesh over the olives and weigh down firmly with a heavy plate to keep the fruit submerged. Olives will darken if exposed to air during curing, so keeping the olives submerged in liquid will help prevent this undesirable color change.
4. Let the olives stand and allow the lye to penetrate the olive flesh about ¾ of the way to the pits—this usually takes at least 5 hours. Check the olives every 1 to 2 hours using the *Test for lye penetration* as described in the sidebar.
5. When the lye penetration is adequate, pour off the lye solution and quickly cover the olives with cold water.
6. Change the water 3 to 4 times during the next 24 to 30 hours to wash the olives (to remove lye). Avoid exposing the olives to the air during washing to keep olives from darkening. Do not wash the olives more frequently than this, since that would leach out the sugars needed for fermentation. After 24 hours, taste the olives to check that you can no longer taste the lye (lye tastes soapy). The olives will still have a slightly bitter taste.
7. Prepare brine. The amount of salt to use depends on the size of olives. For small olives (e.g., Manzanillo and Mission varieties), which do not shrivel easily in salt brines, prepare strong brine with 1 pound (1½ cups) of pickling salt per gallon of water. For large olives (e.g., Sevillano and Ascolano varieties), which shrivel easily

Test for lye penetration:

To test how far the lye has penetrated the olives during a curing process, carefully remove several olives from the lye solution (using a plastic, wooden, or stainless steel spoon) and rinse under plenty of running water. Cut sample olives to the pit with a sharp knife. If you are curing different-sized olives, test the largest fruits for lye penetration. The lye solution discolors the flesh to a yellowish green color. Olives that are completely penetrated will have uniformly yellowish green flesh from the skin to the pit. If the lye has not penetrated completely, you will see milky white flesh surrounding the pit and extending out to where it meets the lye-discolored flesh.

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NOTE: For Manzanillo or Mission varieties, you may need to add sugar or syrup to the brine to increase the fermentation and develop the greater acidity desired by some people. Do not add sugar or syrup, though, until the fermentation has been underway for at least 4 days. You can use white sugar, cane syrup, corn syrup, or beet syrup. Add 1½ level teaspoons of sugar or 2 level teaspoons of syrup per gallon of brine.

- in strong salt brines, prepare a medium-strong brine with 10 ounces (1 cup) of pickling salt per gallon of water.
8. After washing the olives, quickly pack them in suitable containers (described below) and completely fill the containers with prepared brine (see Step 7). Loosely close the container lids. For small quantities of olives, use quart-sized glass jars that have tight fitting lids. For larger quantities of olives, use 1- to 5-gallon glass jars, food-grade plastic pails, kegs, or large oak barrels. One gallon of olives in brine contains about 5½ pounds of fruit.
 9. Add “starter cultures” of lactic acid bacteria at this step in the olive curing process. You can obtain a starter culture from bulk (unheated) dill pickle or sauerkraut brine. If you do not make dill pickles or sauerkraut, you may be able to find the unheated commercial product in a specialty deli. Do not use canned sauerkraut or dill pickle brine, since that will not have any active bacteria. Add this brine at a rate of 6 fluid ounces (¾ cup) per gallon of olives and brine.
 10. Store the olives in a place where the average temperature is below 100°F. Fermentation will be most rapid at temperatures between 70° and 90°F. During the initial period of active fermentation (4 or 5 days), a large amount of gas forms and causes a great deal of foaming and frothing, so take great care to replace any lost brine. Keep the containers full of brine at all times. Later, when gas production is not so violent, tighten the lids to keep out the air and minimize surface yeast and mold growth. Replacement brine should be made with 10 ounces (1 cup) of pickling salt per gallon of water.
 11. Allow the olives to stand for about 2 to 6 months in brine. Olives of this type grow more flavorful with a longer fermentation. Fermentation is complete when the olives have developed the desired acidity and characteristic taste of Spanish-style green olives.
 12. Spanish-style green olives can be stored in brine for up to a year in a cool, dark, dry place.

METHODS FOR PRESERVING CURED OLIVES

Once olives have been cured by brine, lye, or dry salt treatments, they are often placed in light or medium brine or in oil. For longer storage, you can preserve some cured olives in very strong brine, or by freezing, drying, or pressure canning.

CONCENTRATED BRINE

Cured olives can be preserved in heavily concentrated brine and stored at room temperature in this brine for 8 to 9 months. Prepare very strong brine using about 2½ pounds (4 cups) of pickling salt per gallon of water. Cover olives with the brine and let stand. After 2 days, add an additional 10 ounces (1 cup) of pickling salt for each gallon of brine used, and mix well. After two more days add another 10 ounces (1 cup) of pickling salt and mix well. Cover the olive container tightly for storage.

Before you eat these olives, soak them in fresh water: rinse and change the soaking water four times over a period of 2 days.

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FREEZING OLIVES

You can satisfactorily freeze olives that have a higher oil content (e.g., Mission, Kalamata, and Picholine varieties) if they have been dry salt cured or lye cured, but other olive varieties soften too much when you freeze them. Dry salt cured olives, prepared as described earlier, can be packed directly into containers (see below) without additional treatment. Lye-cured olives prepared using the green or dark ripe style methods described earlier must be boiled in brine before you freeze them. For the brine treatment, place olives in a stainless steel saucepan and cover with light brine made with 4 ounces (6 level tablespoons) of pickling salt per gallon of water. Boil the olives in brine for 10 to 15 minutes. This treatment will reduce softening during freezing. Discard the brine, rinse and chill the olives in cold water, and then drain.

Pack the olives (do not use brine) into airtight, moisture-resistant plastic containers, freezer-safe glass jars, or plastic freezer bags to prevent the olives from drying out during storage. You can keep olives in a home freezer (0°F) for up to 1 year.

Before serving, allow the olives to thaw thoroughly. If desired, you can roll the thawed olives in olive or salad oil mixed with chopped garlic or other seasonings.

DRYING OLIVES

Drying (dehydration) is the process of slowly removing water from food to preserve the food. You can successfully dry lye-cured green and dark ripe style olives, without further treatment, in the sun or in a home dehydrator. You can also dry naturally black ripe olives—these are first blanched and then brine treated for 3 days before drying in the sun or a dehydrator (see pretreatment details, below). Dried naturally black ripe olives will be slightly bitter because little oleuropein is leached out in the mild pretreatment. Dried olives can be used in cooking or eaten out-of-hand without soaking.

The amount of time it takes to dry olives depends on their moisture content, the olive variety and size, the volume being dried, the air's humidity during the drying process, and the dehydrator's efficiency.

Naturally black ripe olive pretreatment: Place olives in boiling water for 3 minutes. Drain olives and place them into a food-grade plastic, glass, or stainless steel container. Cover the olives with strong brine made by adding 1 pound (1½ cups) of pickling salt per gallon of cool water; close container loosely. Store olives in brine for 3 days, and then drain off the brine. These olives are now ready for drying.

Sun drying

The high salt and oil content of cured or pretreated naturally black ripe olives make them safe to dry outdoors when conditions are right for drying (minimum temperature of 85°F and humidity less than 60%). Under these conditions, sun drying takes about 5 to 6 days. Insects and birds may be attracted to drying olives, though, and they may contaminate them. If you wish to try sun drying, please consult other reliable references on the subject. One good information source is *Preserving Food: Drying Fruits and Vegetables*, available online from the University of Georgia at http://www.uga.edu/nchfp/publications/uga/uga_dry_fruit.pdf.

Dehydrator drying

Unlike sun drying, which depends on proper weather conditions, dehydrator drying can be done at any time. There is an initial expense involved when you buy a dehydrator, but many people think that a dehydrator produces the best-quality dried food. An electric dehydrator can maintain low, even temperatures, circulating the heated air by means of a blower or fan. Most dehydrators are equipped with thermostats to maintain a constant temperature, and some have timers. Larger units with many shelves have room for more food than most ovens.

Set the dehydrator temperature at 140°F. If your dehydrator does not have a thermostat, place an accurate, easy-to-read thermometer on the bottom tray. Arrange whole pretreated black ripe olives or lye-cured olives on drying trays in a single layer so the fruits do not touch or overlap. Leave 1 to 2 inches between trays. It may be necessary to turn the olives and rotate the trays up and down the stack during the drying process. Olives will be dry in approximately 20 to 24 hours.

Packaging and storage

After drying, cool the olives for 30 to 60 minutes before packaging. Avoid packaging warm olives, since that could lead to sweating and moisture buildup. But you should also avoid long delays before you package because the olives may have an opportunity to reabsorb moisture from the air that may cause them to spoil later.

Dried olives can be stored in sealed plastic bags or airtight containers. Pack the olives tight in the bag or container, removing as much air as possible. If you use metal containers, place the olives in a plastic bag first in order to prevent reaction with the metal. The dried olives will keep for 3 to 4 months in a cool place, but they tend to become rancid if stored longer at room temperature. You can keep dried olives in the refrigerator or home freezer (0°F) for about a year.

To rehydrate dried olives, soak them in slightly salted water (½ cup salt per gallon of water) until plump, about 8 to 12 hours. Add garlic and spices if desired.

CANNING CURED OLIVES

Disclaimer

A pressure canner must be used if you choose to process olives. Olives are low-acid foods that need very high temperatures (at least 240°F) for proper sterilization and safe canning. These high temperatures can only be reached under pressure. NEVER use a boiling water bath canner or a steam canner to can olives. If not properly sterilized, home-canned olives are a potentially dangerous source of food poisoning, including botulism. Carefully follow the pressure canning directions given below to help eliminate the danger of spoilage or food poisoning.

Preparation of olives

The most suitable olives for home canning include the lye-cured and lye-cured fermented olives, such as **Green olives**, **Dark ripe style olives**, and **Spanish-style green olives**. Prepare these olives according to the instructions provided earlier in this publication, and then follow the directions below for canning. Olives for home canning must be left whole (not minced, crushed, chopped, or sliced) and then packed in brine.

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Using the right equipment

Containers for canning

Make sure all glass jars are free of cracks and chips. These defects will prevent airtight seals. Jars that are manufactured specifically for home canning are recommended. Glass mayonnaise jars and similar jars are not recommended for use in home canning because they are not manufactured for repeated heating and have a higher rate of breakage, particularly in pressure canners. Wash the jars in hot, soapy water and rinse them, or you can wash them in a dishwasher.

Lids and rings

Select the correct size of lids to fit your jars. Always use new lids each time you are canning. Ring bands can be reused if they are in good condition. Wash and thoroughly dry the rings before you store them and they will remain in good condition for years. Follow the manufacturer's instructions for pretreating the canning lids. Metal lids have a sealing compound and usually need to be heated prior to use.

Filling jars

Prepare a brine using 4 ounces (6 level tablespoons) of pickling salt per gallon of water. Heat the brine to boiling. Pack the prepared olives to the shoulder of the jar and cover completely with the boiling brine, leaving a ½-inch headspace (fig. 2). Do not overfill the containers. Do not let the jars stand on a cold surface while you are filling them, as the jars may crack. After adding brine to the recommended headspace, use a plastic knife or spatula to dislodge air bubbles trapped inside the jars. Then add more brine if necessary.

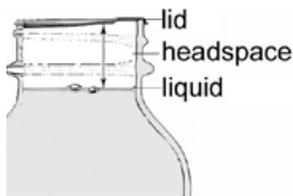


Figure 2. Leave adequate headspace in jars.

Adjusting seals

With a clean, damp cloth or towel, carefully wipe the rim and screw threads of the jar. Place the clean, prepared lid on the rim of the jar and screw the ring band on firmly. Do not overtighten. If tightened too much, the lids will not vent correctly, causing buckling of the lid, loss of the seal a day or two after processing, and possibly glass breakage during processing.

Using a pressure canner

Follow the instructions provided by the manufacturer of your pressure canner if the canner was purchased after 1990. Make sure that the canner is in good working order and that its pressure gauge is accurate. Modern pressure canners may have a dial gauge to indicate pressure or a weighted gauge to indicate and regulate pressure.

A free online publication from the University of California, *Safe Methods of Canning Vegetables* (UC ANR Publication 8072), provides detailed information on using pressure canners safely, including those canners purchased before 1990. You can access the publication at <http://anrcatalog.ucdavis.edu>. The National Center for Home Food Preservation is another reliable source of information; their publication, *Preserving Food: Using Pressure Canners*, is available online at http://www.uga.edu/nchfp/how/can_home.html.

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Choose a suitable rack

Use a rack that is steady in the bottom of the canner. Do not use a solid piece of wood or metal. You can use a shallow, openworked wire rack if the openings are narrow enough to prevent the jars from tilting. For two layers of jars, use a second rack set high enough to separate the layers. For small jars, use a rack that is high enough to allow at least 2 inches of water in the bottom of the pressure canner—the jars should not be covered with water.

Use enough water in the canner

Water is necessary to form steam for exhausting (venting) and pressurizing the canner. When you have your jars of food ready for canning, put the rack and hot water into the canner. Use about 2 to 3 inches of hot water in a dial gauge canner—this will be enough water to keep the canner from boiling dry. Use an additional 1 to 2 inches of water in weighted gauge canners that continually vent steam during the processing time. It is all right for the water to come to within 2 inches of the tops of the cans or jars. The amount of water you use will vary with the height of the rack, the size and number of jars, and the diameter of the canner. Heat the water to a simmer and keep it hot.

Venting the canner

Arrange the hot, filled jars fitted with lids on the rack in the canner so that they do not touch each other or the canner wall. Securely fasten the canner's lid according to the manufacturer's instructions. Open the petcock or leave the weight off the vent pipe. Place the canner over high heat and bring the water to a boil and allow steam to flow freely from the petcock or vent pipe. Keep the heat setting at high and let the steam flow for **at least 10 minutes** to “vent” the canner. All of the air must be removed so that the temperature will rise as high as it should at a given steam pressure.

Processing using a pressure canner

After venting the canner, close the petcock or place the weight on the vent pipe. The canner pressure will rise during the next several minutes. Start timing the process when the weighted-gauge canner reaches 10 pounds pressure, indicated by the rocking of the weighted gauge, or when the dial-gauge canner reaches 11 pounds pressure as shown on the dial gauge. For elevations above sea level, increase the pressure in the canner according to the figures in [table 2](#). Local elevations may be found online, typically at sites that also report the weather. You may also check with your county University of California Cooperative Extension office for altitude information.

Table 2. Recommended canning pressures at various elevations (altitudes)

Type of canner	Processing pressure (psi*) at various elevations (ft)				
	Sea level to 1,000 ft	1,001 – 2,000 ft	2,001 – 4,000 ft	4,001 – 6,000 ft	> 6,000 ft
Weighted gauge	10	15	15	15	15
Dial gauge	11	11	12	13	14

* pounds per square inch.

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Process olives packed in brine for 60 minutes for pints or 70 minutes for quarts at the recommended pressure (see table 2). Control the heat to keep the pressure constant—check the canner manufacturer's instructions to see how to maintain the recommended pressures. A loss of pressure can result in underprocessing and unsafe food. If the pressure falls below the recommended level at any time, bring the canner back to pressure and begin timing over again from the beginning, using the total original processing time.

Cooling and opening the canner

After processing is finished, turn off the heat. It is best not to move the canner while it is cooling. If you move the canner do not tilt it and do not set it on a cold surface. For dial gauge canners let the pressure return to zero, wait a few more minutes, and then gradually open the petcock and remove the canner cover. For weighted gauge canners the cooling must be timed: at least 30 minutes for pints and 45 minutes for quarts. After this cooling time, no steam should escape when the weighted gauge is gently nudged. Open the vent pipe before you remove the cover of the canner. Open the lid away from you to protect yourself from any remaining steam that escapes.

Removing and storing jars

Use a jar lifter to remove the jars from the canner or hold a dishcloth over the top of each jar as you lift it. Place jars on a towel, board, or cooling rack, not on a cold surface. Bubbling in the jars is normal—it is the sign of a good seal and means that the contents are boiling under vacuum. Do not tighten any loose ring bands after processing. Retightening may damage the seal. Let the jars stand undisturbed for 24 hours to cool completely.

After 24 hours, test each jar's seal by pressing one finger on the middle of the lid—the lid should stay depressed and should not move. For jars with good seals, remove the ring bands and wipe the jars with a damp cloth. Label and date the jars and store them in a cool, dark, dry place. You can expect to keep canned green or dark ripe olives for 1 year if you have prepared them correctly. After that their quality will begin to decline.

Steam pockets frequently form in the flesh of olives that are home canned in glass jars. If the pocket formation is so extensive that the olives are honeycombed, they will lose firmness, but this is a harmless defect.

Reprocessing

Jars that did not seal can be refrigerated and used within a few days or you can reprocess them within 24 hours. To reprocess, use a new metal lid and check each jar for flaws. Empty the contents of the jar(s) into a saucepan and bring it to a boil. Fill clean, hot jars and process for the full length of time (60 or 70 minutes) originally recommended.

Disposal of spoiled and questionable olives

Botulism is a food poisoning that can be fatal. It is caused by eating the poison produced by the bacterium *Clostridium botulinum*, which can grow in low-acid foods (>pH 4.6) in the absence of air. Lye-cured non-fermented olives are low-acid foods. Olives canned improperly at home have caused botulism poisoning.

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If olives become moldy, soft, or bad smelling at any time during curing or preserving, do not eat them or even taste them. Never taste canned olives that appear to be spoiled. Corroded lids, bulging or rusted containers, and jars with liquid oozing from under the lid are signs of canned food spoilage. If the contents of the jar appear moldy, gassy, or have a disagreeable odor, discard the food carefully. Never feed spoiled or questionable olives to animals or poultry: animals and birds can be sensitive to botulism.

Before discarding spoiled or questionable olives, you must detoxify the container and its contents using the following procedure. Wearing intact rubber gloves, carefully remove the lid from each jar and place the jars (no more than 2 to 3 jars at one time) containing spoiled food on their side in an 8-quart or larger stockpot, pan, or boiling-water canner. Do not remove the food from the jars, since removal could contaminate other items. Place the lid in the pot with the jar. Carefully add water to the pot—the water should completely cover all of the jars with at least 1 inch of water above the jars. **Do not splash water or food product** outside the pot. Place a lid on the pot and heat the water to boiling. Boil for 30 minutes to ensure that the food, jars, and lids are detoxified. Allow the contents to cool. Drain the water and discard the food and lids in a heavy plastic trash bag. The jars can be reused. Thoroughly wash all counters and equipment, including can openers, clothing, and hands that may have contacted the food or containers. To clean surfaces and utensils, use a solution of 1 part chlorine bleach to 5 parts water. Wet surfaces with this solution and let stand for 5 minutes before rinsing. Discard any sponges or dishcloths that you use in the cleanup. Place them in the plastic trash bag with the detoxified food and lids, close the bag securely, and dispose of it in a regular trash container.

If someone has tasted questionable food and becomes ill, immediately contact your local hospital emergency room, Poison Control, or a doctor. If possible, save the jar of the questionable food for the health officials. The classic symptoms of botulism include double vision, blurred vision, drooping eyelids, slurred speech, difficulty swallowing, dry mouth, and muscle weakness. All of these are symptoms of the muscle paralysis caused by the bacterial toxin. If untreated, these symptoms may progress to cause paralysis of the arms, legs, and trunk, and the respiratory muscles. In foodborne botulism, symptoms generally begin 18 to 36 hours after eating a contaminated food, but they may occur as soon as 6 hours or as late as 10 days after eating the food.

Approximate metric equivalents

U.S. unit	Metric
1 teaspoon (tsp)	5 milliliters (ml)
1 tablespoon (tbsp)	15 milliliters (ml)
1 ounce (oz)	28 grams (g)
1 cup	250 milliliters (ml)
1 pint (pt)	500 milliliters (ml) or 0.5 liter (L)
1 quart (qt)	1 liter (L)
1 gallon (gal)	4 liters (L)
1 pound (lb)	454 grams (g) or 0.45 kilogram (kg)
1 inch (in)	2.5 centimeters (cm)
1 foot (ft)	0.3 meters (m)
Fahrenheit (°F) °F = (°C × 1.8) + 32	Celsius (°C) °C = (°F – 32) ÷ 1.8

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FREQUENTLY ASKED QUESTIONS

What cause olives to soften?

The softening of olives during processing is a complex problem. Some varieties, such as Ascolano and Barouni, just have a tendency to soften. Other common reasons for softening include (1) using overripe olives, (2) allowing picked olives to overheat, (3) the action of enzymes during prolonged storage of olives before processing, (4) using a lye solution that is too strong or at too high a temperature, and especially (5) the action of microorganisms such as molds, yeasts, and bacteria.

Some molds and bacteria that grow on the surface of storage brine produce large amounts of pectin-degrading enzymes. Pectin acts as the cementing substance in the cells of the olive. Olives can soften rapidly, usually within 2 weeks, in the presence of these enzymes. To prevent this softening, check the storage brine periodically and remove any scum that forms on the surface.

Microbial softening of olives is sporadic and may not occur in all containers at the same time. Preventive measures include keeping containers covered, using a storage brine that is at least 10 percent salt (13 ounces [1¼ cups] of pickling salt per gallon of water), storing olives in the refrigerator, or pressure-canning the olives.

Why do blisters and gas pockets form in some olives?

Blisters may form in green olives when they are treated with too strong a lye solution. The olive skin can lift (blister) or shed during lye curing. To prevent this problem, test different strengths of lye with a sample of olives. Blistered olives are safe to eat.

Certain bacteria can also cause blisters to form between the skin and flesh of olives—these blisters are called *fish eyes*. The bacteria can grow just under the skin of the olive, producing gas and forming small blisters on the fruit. If these bacteria are deeper in the olive tissue they can cause gas pockets to form within the olives. This usually occurs during the washing process that follows the lye soak, but it can be prevented if you change the water at frequent intervals until the washing process is finished.

Why are my olives foaming during lye treatment?

Foaming sometimes occurs during lye curing of overripe olives that have reached their maximum oil content. The excess oil reacts with the lye, causing the foam. If foaming occurs during a lye soak, drain the olives and place them into a freshly prepared lye solution.

What is food-grade plastic?

The U.S. Food and Drug Administration (FDA) requires that plastics used in food packaging (commonly referred to as *food-grade plastic*) be of greater purity than plastics used in non-food packaging. Food-grade plastic containers may contain some recycled plastics but they do not contain dyes or recycled plastics that are considered harmful to humans. Plastic containers that are suitable for use in pickling are typically made from HDPE (high density polyethylene), PP (polypropylene), or polycarbonate. In general, the white opaque plastic buckets that contain food for human consumption are made of food-grade HDPE, and you can re-use them for pickling. However, a plastic container can no longer be considered food grade if it has been used to store non-food items like chemicals, paints, or detergent.

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ADDITIONAL RESOURCES

UC Food Safety at UC Davis provides information about food safety and has links to resources on home food preservation. <http://ucfoodsafety.ucdavis.edu>

The National Center for Home Food Preservation provides science-based information on home food preservation for Extension educators, other educators, and home food preservers. <http://www.uga.edu/nchfp>

The University of Georgia College of Family and Consumer Sciences, Food Safety and Preservation Section provides extensive publications on preserving food safety as well as other food-related information. <http://www.fcs.uga.edu/ext/pubs/index.php>

California Rare Fruit Growers is a nonprofit educational organization that provides information on tree crop culture, including the culture of olive trees in California. <http://www.crfg.org/pubs/ff/olive.html>

The University of California Fruit and Nut Research and Information Center has links to publications and Web sites for many fruit and nut crops, including olives. Primarily intended for farmers and commercial or specialty olive or olive oil producers. <http://fruitsandnuts.ucdavis.edu/crops/olive.shtml>

Olive Production Manual, 2nd Edition (UC ANR Publication 3353) by G. S. Sibbett and L. Ferguson, University of California, 2005. This manual for commercial growers covers production techniques, pest management, postharvest processing, and olive oil production. Information on ordering this publication from the University of California's Division of Agriculture and Natural Resources (ANR) catalog is available online at <http://anrcatalog.ucdavis.edu>

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Figure 2 is from *So Easy to Preserve* (University of Georgia Cooperative Extension Bulletin 989), and is used here by permission.

FOR MORE INFORMATION

You will find related information in these titles and in other publications, slide sets, CD-ROMs, and videos from UC ANR:

Olive Production Manual, 2nd Edition, Publication 3353

Organic Olive Production Manual, Publication 3505

Producing Olive Oil in California, Publication 21516

To order these products, visit our online catalog at <http://anrcatalog.ucdavis.edu>. You can also place orders by mail, phone, or FAX, or request a printed catalog of publications, slide sets, CD-ROMs, and videos from

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