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Tomatoes: Safe Methods to Store, Preserve, and Enjoy

TRACY L. PARNELL is Postgraduate Researcher, Department of Food Science and Technology, UC Davis; **TREVOR V. SUSLOW** is Postharvest Extension Specialist, Department of Vegetable Crops, UC Davis; and **LINDA J. HARRIS** is Food Safety and Applied Microbiology Specialist, Department of Food Science and Technology, UC Davis.

UNIVERSITY OF CALIFORNIA
Division of Agriculture and Natural Resources
http://anrcatalog.ucdavis.edu

WHAT IS A TOMATO?

The common garden tomato (*Lycopersicon esculentum* Mill.) is botanically classified as a fruit. Actually it is a berry, but many people think of it as a vegetable. The U.S. Department of Agriculture, for example, has defined it as a vegetable. The modern tomato originated in the southern regions of the Andes Mountains, the coastal deserts of Peru, and Ecuador and parts of central Mexico. By the time Europeans arrived in the New World, tomatoes were already widely cultivated by the Aztecs as far north as Mexico. The Aztec (Nah'uatl) word *tomatl* is a term that roughly translates as "plump fruit." In the early 16th century, Spanish explorers changed *tomatl* to *tomate*.

Tomato seeds probably arrived in Europe through Seville, Spain, a major center of European trade. In 1544, the Italian herbalist Mattioli referred to the yellow fruits of the tomato plant as *Mala aurea*, the golden apple. Later, in 1554, he mentioned a red variety. The fruit gained undeserved reputations in various cultures as having poisonous or aphrodisiac qualities. Tomatoes are low in calories and a good source of Vitamins A and C (Figure 1).

Tomato, raw

Nutrition Facts

Serving Size 1 medium whole (123 g)

Amount Per Serving

Calories 25 Calories from Fat 0

	Daily Value*
Total Fat 0.4 g	1%
Saturated Fat 0g	0%
Cholesterol 0 mg	0%
Sodium 11.1 mg	0%
Total Carbohydrate 6g	2%
Dietary Fiber 1.4 g	1%
Sugars 4.3g	
Protein 1 g	

Vitamin A	15%	• Vitamin C	39%
Calcium	0%	• Iron	0%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

		Calories:	2,000	2,500
Total Fat	Less than		65g	80g
Sat Fat	Less than		20g	25g
Cholesterol	Less than		300mg	300mg
Sodium	Less than		2,400mg	2,400mg
Total Carbohydrate			300g	375g
Dietary Fiber			25g	30g

Calories per gram:
Fat 9 0 • Carbohydrate 4 • Protein 4

Figure 1. Nutrition facts for tomatoes.

California produces about 30 percent (5000 to 6000 tons per year) of U.S. fresh-market tomatoes, and about 95 percent (8 to 11 million tons per year) of tomatoes used for processing. Tomatoes grown in California are harvested from May to December, with peak periods from July through mid-August. The United States imports greenhouse tomatoes year-round from Canada, Mexico, and the Netherlands. Field tomatoes are imported from Mexico from December through April.

The flavor, texture, and cooking characteristics of tomatoes depend on the variety, growing method, local environment, and handling techniques used during and after harvest. Because processing and fresh-market tomato varieties are used in very different ways, they have been bred and selected for traits important to their specialized growing, harvesting, shipping, processing, and consumption requirements.

GROWING TOMATOES IN THE HOME GARDEN

There are more than 400 varieties of tomato—including hundreds of specialty and heirloom types—that are suited for growing in the home garden. You can choose the varieties that work best in your area if you want to maximize productivity, but you should also know that many types will produce at least some fruit in very different climates. Many useful resources are available to help you with variety selection and production of tomatoes. One good reference, *Home Garden Tomatoes: A Production Guide and Recommended Varieties for California*, is available online at http://vric.ucdavis.edu/selectnewcrop.tomato.htm. At the same Web site, you can find

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information on management of tomato pests, diseases, and disorders, such as blossom-end rot and fruit cracking. *Key Points of Control and Management of Microbial Food Safety: Edible Landscape Plants and Home Garden Produce* (UC ANR Publication 8101, available free of charge at http://anrcatalog.ucdavis.edu), provides information on minimizing the contamination of fruits and vegetables in the home garden by organisms that cause foodborne illness.

SELECTING TOMATOES FROM THE HOME GARDEN

Tomato eating quality is largely a matter of personal preference. Normally, tomatoes are harvested from the vine when fully colored (red, yellow, purple, multi-colored, etc.) but still firm. When the first signs of color appear, typically at the blossom end, the tomato is mature and edible, but not fully ripe. By the time a tomato reaches about 20 percent of full-ripe color, it has reached its full balance of sweetness and acidity potential. Peak flavor for the variety can develop on or off the vine from this point onward, with proper handling. Generally, fruit is left on the vine until at least 80 percent of its ripe color has developed.

Tomatoes harvested with 60 to 80 percent of full color can be ripened in the kitchen. The optimal method is to place the fruit in a ripening dome or paper bag (not plastic) out of direct sunlight to maintain the right balance of humidity. The very low humidity conditions that are typical in Central California result in water loss and premature softening of harvested fruit that are left in the open. Excessive humidity during ripening encourages decay and spoilage. Some venting in a ripening dome is essential to prevent a buildup of carbon dioxide, since tomato ripening is inhibited without fresh air.

Cherry tomatoes are best when picked at about 85 to 95 percent of full color. If left on the vine until fully ripe, they tend to over-soften or crack.

SELECTING TOMATOES AT RETAIL

At least 10 types of tomatoes are marketed at U.S. retail outlets. They are grown using conventional, organic, and greenhouse methods. The key factors for selecting tomatoes at the market are hard to generalize, since they vary depending on intended use and personal preference. Here are a few guidelines, though, for judging firmness, texture, and flavor of tomatoes for use in salads and sandwiches.

- Tomato skin should appear bright and well colored for the type of tomato. At retail, red tomatoes should have at least some red color for best eating. Light-pink tomatoes may ripen further at home after 2 to 3 days and achieve a flavor quality comparable to that of vine-ripened fruit of the same variety. Pale pink tomatoes that have been mishandled by being held too cold for too long, however, will never properly ripen. Yellow tomatoes should have a medium yellow hue, rather than a deep yellow or yellow-orange color that indicate over ripening.
- Fruit should be firm or should yield slightly (depending on your preference) when gently squeezed with the fingertips. No deformity should be visible when you release pressure.
- Fruit surface should not wrinkle when you slide your thumb, with slight pressure, from blossom-end to stem-end. Tomatoes should be free of darkened or bruised areas under the skin, which may be signs of mishandling and may make the tomatoes unusable after cutting.

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•For cluster "vine-ripened" tomatoes, select firm tomatoes attached to bright green, flexible vines (i.e., vines that can bend slightly without breaking) for peak flavor and texture. Vines that have become dull and dehydrated may still hold fruit of good to excellent eating quality. Bright red color and overall firmness of the fruit, rather than vine color, are the best indicators of freshness.

Figure 2. Stem scar end of a tomato. The blossom end is directly opposite of the stem scar.

STORING FRESH TOMATOES

If purchased from a retail outlet, most ripe tomatoes retain best eating quality for 2 to 3 days if stored at room temperature. Store fruit away from direct sunlight with the stem scar (Figure 2) facing up to reduce softening and darkening of the fruit. You can hold underripe tomatoes from a retail outlet for as long as 5 days. For short-term storage, it is best to keep the tomatoes in a well-vented ripening dome or a paper bag at the coolest room temperature possible. Be sure to keep the fruit out of direct sunlight as it will warm the fruit and cause more rapid softening.

Many tomato varieties have been bred to enhance traits that extend the fruit's storage life, including some large-fruited "vine-ripe" types, cluster tomatoes, and many cherry and Roma types. They may be held at room temperature for up to 5 days.

NOTE
Refrigeration is not recommended for *whole* tomatoes, except for short-term storage of completely ripe fruit.

Refrigeration is not usually recommended for fresh tomatoes as it can cause flavor loss. You can, however, delay softening of "just-ripe" tomatoes by holding them for a short time in refrigerated storage. Flavor loss will be minimal if cold storage lasts less than 3 days. If you need to refrigerate tomatoes, place them in the crisper section in their plastic clamshell container (if that is how they were packaged in the store), a paper bag, or a plastic bag with a few slits, to reduce water loss. This is most important for cherry and grape tomatoes. Excessive water loss is first noticeable as wrinkling or puckering of the fruit's skin. It is best to remove the fruit from the refrigerator 1 hour before eating to help it regain some of its original flavor.

SAFETY TIPS FOR HANDLING FRESH TOMATOES

General Sanitation

On occasion, tomatoes have been linked to foodborne illness caused by *Salmonella* bacteria. Like any other fresh fruit or vegetable, tomatoes can be contaminated by bacteria from soil, water, and animal sources. Contamination from human sources may occur before, during, or after harvest, right up to the point of consumption. Bacteria on the tomato's skin can be transferred to its internal flesh during cutting or slicing. Food poisoning outbreaks have occurred when poorly washed utensils or cutting boards (especially those used to handle raw meats) have been used to prepare fruits or vegetables. For this reason, it is important that you wash your hands with soap and water before and after preparing produce, and that you use clean equipment, utensils, and cutting surfaces.

Washing Tomatoes

Tomatoes should be washed before cutting. To wash, wet each tomato with water, rub its surface, rinse it with running water, and dry it with a paper towel. After washing, cut away the stem scar and surrounding area and discard it before slicing or chopping the tomato.

CAUTION
Always cover and refrigerate *cut* tomatoes when preparing them in advance. Throw out cut tomatoes if they have been held for longer than 2 hours at room temperature or 1 hour at temperatures over 90°F (32°C).

Washing tomatoes in a sink filled with water is not recommended since contaminated water can be absorbed through the fruit's stem scar. The use of soap or detergent is neither recommended nor approved for washing fruits and vegetables because they can absorb detergent residues.

Cut or chopped tomatoes or products made from them, such as fresh salsa, should always be covered and refrigerated if they are not consumed within 2 hours of preparation. Cut or chopped tomatoes will last about 1 to 2 days if refrigerated.

METHODS FOR PRESERVING TOMATOES

Tomatoes are generally considered to be acidic, but their pH can vary significantly depending on their degree of ripeness and their variety. In general, the more ripe the tomato, the higher (less acidic) is the pH. The pH of whole, ripe tomatoes ranges from 4.3 to 4.9, putting some tomatoes in the low-acid range (defined as a pH greater than 4.6).

Freezing Tomatoes

Tomatoes may be frozen whole, sliced, chopped, or puréed. Additionally, you can freeze them raw or cooked, as juice or sauce, or prepared in the recipe of your choice. Thawed raw tomatoes may be used in any cooked-tomato recipe. Do not try to substituted them for fresh tomatoes, however, since freezing causes their texture to become mushy. Tomatoes should be seasoned just before serving rather than before freezing; freezing may either strengthen or weaken seasonings such as garlic, onion, and herbs.

Preparation. Select firm, ripe tomatoes for freezing. Sort the tomatoes, discarding any that are spoiled. Wash them in clean water as recommended above. Dry them by blotting with a clean cloth or paper towels.

Freezing whole tomatoes. Prepare tomatoes as described above. Cut away the stem scar. Place the tomatoes on cookie sheets and freeze. Tomatoes do not need to be blanched before freezing. Once frozen, transfer the tomatoes from the cookie sheets into freezer bags or other containers. Seal tightly. To use the frozen tomatoes, remove them from the freezer a few at a time or all at once. To peel, just run a frozen tomato under warm water in the kitchen sink. Its skin will slip off easily.

NOTE
You can peel tomatoes easily if you first dip them into boiling water for about 1 minute or until the skin begins to split.

If you prefer to freeze peeled tomatoes, you can wash the tomatoes and then dip them in boiling water for about 1 minute or until the skins split. Peel and then freeze as noted above.

Freezing stewed tomatoes. Prepare tomatoes as described above. Peel tomatoes by dipping them in boiling water for about 1 minute or until the skin begins to split. Core and quarter the tomatoes. Add tomatoes and other ingredients, if desired, to a pan. Cover and cook until tender (10 to 20 minutes). Cool the tomatoes by placing the cooking pan into a sink or larger container of cold water, stirring often. Pack the cooled tomatoes into freezer containers, leaving a $1\frac{1}{2}$-inch (3cm) headspace for expansion. Seal and freeze.

Freezing tomato juice. Prepare tomatoes as described above. Cut tomatoes into quarters or eighths. Heat rapidly to boiling; reduce the heat and simmer 5 to 10 minutes. Cool the tomatoes. Press them through a sieve or food mill to separate the pulp from the skin and seeds. Pour the juice into containers, leaving a $1\frac{1}{2}$-inch (3cm) headspace for expansion. If desired, you can add $\frac{1}{2}$ teaspoon (2 ml) of salt for flavor to each quart of juice. Seal and freeze.

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Figure 3. Oval, plum, Roma, or paste tomato.

Drying Tomatoes

Dehydration removes water from tomatoes in order to preserve them. The amount of time it takes to dry tomatoes depends on the tomato variety, the air's humidity during the drying process, the thickness of the tomato slices or pieces, and the efficiency of the dehydrator or oven.

The best tomatoes to dry are firm, ripe, and meaty. This type is usually oval shaped and called an Italian, Roma, plum, pear, or paste tomato (Figure 3). These varieties contain fewer seeds and more pulp and so produce dried tomatoes of better quality. Varieties such as beefsteaks that contain high levels of gel (called *locular gel*) surrounding the seeds are not recommended for drying.

The secret to dehydrating tomatoes successfully is to control the temperature and air circulation. If held at too low a temperature (less than 90°F [32°C]) the product will dry too slowly, giving bacteria or mold a chance to grow. At temperatures of 170°F (77°C) or more, the tomatoes cook or harden on the outside, while the inside remains moist, allowing spoilage. Optimum drying temperatures are 135° to 140°F (57.2° to 60°C).

NOTE
Properly dried tomatoes have a dark red color and feel dry and leathery, but not hard or brittle. You should be able to bend them easily back and forth. They should not be tacky or moist.

Properly dried tomatoes have a dark red color and feel dry and leathery, but not hard or brittle. They should not be "tacky" or moist. You should be able to bend them easily back and forth. When you touch a properly dried tomato in the center, no tomato pulp should stick to your finger.

Preparation. Select firm, ripe tomatoes for drying. Sort the tomatoes, discarding any that are spoiled. Wash the tomatoes in clean water as recommended above. Tomatoes do not have to be blanched before drying. Cut plum tomatoes almost in half lengthwise and open them like a book. You may remove the seeds or not, based on personal preference. If you wish to remove seeds, use a spoon to scrape them out or gently squeeze the tomato to extract them, being careful not to remove the pulp. When drying plump or thick plum tomatoes, make a slit on the bottom (skin) side to aid in the drying process. Slice round tomato varieties in $\frac{1}{4}$-inch thick slices. Lay the tomatoes cut-side-up on the dehydrator trays.

Figure 4. Typical sun drying rack.

Sun drying. Some areas of California offer the appropriate climate for sun drying. If you live in an area with a low relative humidity (less than 60%) and daily temperatures that reach at least 90°F (32°C), you may be able to use the sun to dry tomatoes. If you live in an area with a climate that is cooler or moister, follow the directions for drying tomatoes in a dehydrator.

To sun dry, place the prepared tomatoes about $\frac{1}{2}$ to 1 inch (1 to 3cm) apart cut-side-up, on clean wooden, plastic, chromed, or non-stick-coated drying trays (Figure 4). Do not use galvanized screening, as it could react with the acid in tomatoes. Cover the arranged fruit with fine netting or cheesecloth to keep insects off.

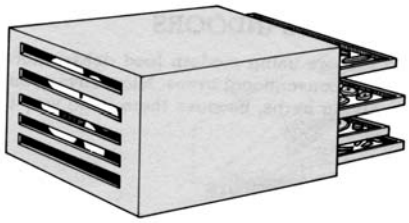
During sun drying, air must circulate around and under each tray, so the trays should not be stacked. The cheesecloth or netting should be raised above the trays so that it does not touch the tomatoes.

Turn the tomatoes from cut-side-up to cut-side-down once a day for even drying. If the temperature at night drops more than 20°F (11°C) below daytime temperatures, bring the trays indoors or place them in a dry, sheltered area at night. This step is important: it prevents the dried tomatoes from reabsorbing moisture. It will probably take at least 5 to 6 days, and perhaps as long as a week, to complete the sun drying process. The time will vary according to the air temperature and the size and type of tomatoes being dried.

Despite precautions, tomatoes dried outdoors can become contaminated by insects. To keep insects from contaminating dried tomatoes, you must destroy any insects and their eggs before storage. To destroy insects and their eggs, place the packaged dried tomatoes in a freezer for 48 hours or spread unpackaged tomatoes on a cookie sheet or in a shallow pan in a preheated 120ºF (49ºC) oven for 2 hours or a 160ºF (71°C) oven for 30 minutes.

Oven drying. Oven drying of tomatoes is possible, but because tomatoes can take up to 40 hours to adequately dry we do not recommend it. This process heats up the kitchen, makes the oven unavailable for other uses, and is unsafe in homes with small children because of the potential for burns. If you wish to pursue oven drying, please consult other references on the subject (e.g., Preserving Food: Drying Fruits and Vegetables [http://www.fcs.uga.edu/extension/food_pubs.php]).

a.



b.

Figure 5. Typical home dehydrators.

Dehydrator drying. Unlike sun drying, which depends on the weather, dehydrator drying can be done at any time. There is an initial expense involved in buying a dehydrator (Figure 5 a and b), but many people think that a dehydrator produces the best quality dried food. An electric dehydrator can maintain a low, even temperature, 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 (Figure 5b).

Set the dehydrator temperature at 135° to 140°F (57° to 60°C). If your dehydrator does not have a thermostat, place an accurate, easy-to-read thermometer on the bottom tray. Place the prepared tomatoes on trays cut-side-up, leaving 1 to 2 inches (2.5 to 5 cm) between trays. It may be necessary to turn the tomatoes and rotate the racks during drying. Because tomatoes may scorch easily close to the end of drying, examine them occasionally and remove individual pieces as they dry. The estimated time for drying tomatoes is 10 to 18 hours, depending on the size of the tomato pieces and the individual dehydrator used.

Microwave drying. Do not attempt to use a microwave oven to dry tomatoes. They require constant attention, and the door must be opened frequently to allow moisture to escape. Microwave-dried tomatoes do not dry evenly, and they can easily scorch or burn.

Packaging and storage. Dehydrated tomatoes require very little storage space. Completely dried tomatoes can be stored in sealed plastic bags, airtight jars, or other suitable containers. If you use coffee cans, place the tomatoes in plastic bags first and seal each bag individually. Pack the tomatoes tightly and squeeze out all excess air. Store them in a cool (60°F [15°C]), dark place. The color, flavor, aroma, and nutritive value of dried tomatoes will deteriorate after about a year. Well-wrapped tomatoes can be stored in the freezer for longer periods.

Rehydrating dried tomatoes. You can rehydrate dried tomatoes in a variety of ways. You can add them directly to soups and stews or soak them in water, wine, bouillon, or vegetable juice. They usually rehydrate within 1 to 2 hours. If you soak them for more than 2 hours or overnight, you should refrigerate them. Use boiling liquid if you want to shorten the soaking time. The liquid used to rehydrate the tomatoes contains vitamins from the fruit and may be used in cooking.

Tomato flakes and powders. To produce flakes or powder from dried tomatoes, dry them beyond the "leathery" stage to a more brittle consistency. Tomato

flakes can be made by pounding the dehydrated tomatoes with a mallet or by crushing them in your hands or with a rolling pin. Powders are finer than flakes, and you can make them using a food processor or blender. Dried tomato flakes and powders can be added to soups, stews, and other foods for color and flavoring.

CAUTION
Do not can overripe tomatoes. Tomatoes decrease in acidity as they ripen.

CAUTION
Tomatoes vary in their acidity. For this reason, all tomatoes must be acidified before canning to prevent botulism, a potentially deadly illness caused by a toxin produced during growth of the bacterium *Clostridium botulinum*.

CAUTION
The acidity of tomatoes can vary significantly over a pH range of 4.3 to 4.9. Values of pH 4.6 and higher are in the low-acid range and tomatoes in this range that are canned without added acid have the potential to develop botulism. It is important that you follow recipes carefully. Do not alter the specified proportions of tomato to lemon juice or other recommended acids when you can tomato products.

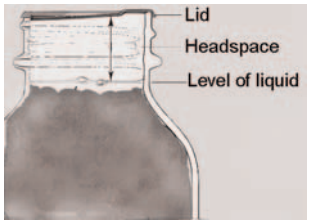


Figure 6. Leave adequate headspace in jars.

Canning Tomatoes

Preparation. Sort tomatoes, discarding any that are spoiled. Do not can overripe tomatoes. Wash the tomatoes in clean water as recommended above. Dip the clean tomatoes in boiling water long enough to crack the skins (about 1 minute). Then dip them in cold water and the steins should come off easily. See Table 1 for specific preparation instructions for each type of canned tomato.

Adding acid to tomatoes. Because the acidity of tomatoes can vary with variety and degree of ripeness, acidification (the addition of lemon juice or other acid) of home processed tomato products is essential. To ensure adequate acidity in tomato products, add 2 tablespoons (30 ml) of commercially bottled lemon juice or $\frac{1}{2}$ teaspoon (2 ml) of powdered citric acid per quart. Citric acid, also called *sour salt*, is found in the spice section at the grocery store.

For pints (500 ml), use 1 tablespoon (15 ml) of commercially bottled lemon juice or $\frac{1}{4}$ teaspoon (1 ml) of powdered citric acid. It is important that you use commercial lemon juice because its acidity has been standardized. You can also use commercial vinegar (at least 5% acetic acid) to acidify tomato products, but since acetic acid is less effective at acidifying, you need to add 4 tablespoons (60 ml) of vinegar per quart (1 L) or 2 tablespoons (30 ml) per pint (500 ml). The addition of vinegar may change the flavor of your canned tomato product.

Add lemon juice, citric acid, or vinegar directly to the jars before filling with product or add it to the top after packing. Add a small amount of sugar to offset any acid taste, if desired. The amount of sugar that you add will depend on the acidity of the tomatoes and your own personal preference.

Using the right equipment. *Glass jars.* Make sure all jars are free of cracks and chips. These defects will prevent airtight sealing. We recommend that you use jars that are manufactured specifically for home canning. Mayonnaise and similar jars are not recommended for use in home canning because they are not manufactured for repeated heating and so have a higher rate of breakage, particularly in pressure canners. Wash the glass jars in hot, soapy water and then rinse, or wash them in a dishwasher.

Lids and rings. Use two-piece metal canning lids. Select the size of lid that fits your jars. Always use new lids each time you are canning. Rings can be reused if they are in good condition (i.e., no rust that would inhibit a proper seal). Wash and thoroughly dry the rings before storage 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 on the contact surface and usually need to be heated prior to use.

Filling jars. Do not overfill the jars. Pack tomatoes to the shoulder of the jar as described in Table 1, leaving room for the covering liquid (if used) and recommended headspace (Figure 6). After adding liquid to the recommended level, use a plastic knife or spatula to dislodge air bubbles trapped inside the jars. Add more liquid if necessary.

Figure 7. Water bath canner.

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 firmly screw on the ring band. 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 possible glass breakage during processing.

Processing. To prevent spoilage, acidic foods such as tomatoes need to be heated to temperatures that destroy yeasts, molds, and bacteria. This heat treatment can be accomplished either in the water bath canner or by a brief process in a pressure canner. Directions are given in Table 1 for a variety of tomato products that are commonly home-canned in California.

Processing using a water bath canner. Any large kettle or pot may serve as a water bath canner (Figure 7) if it is deep enough to allow water to cover the tops of the jars by 1 to 2 inches (Figure 8). Jars should sit on a rack in the canner. If jars come in direct contact with the bottom of the canner they may break. Add enough water to cover the tops of the jars by at least 1 inch. Once the water comes to a gentle boil, begin to count processing time as indicated in Table 1. When the processing time is complete, remove the jars from the canner and let them cool, undisturbed, at room temperature. After cooling, check the jars for a tight seal. Store in a dark, dry, cool place.

Processing using a pressure canner. Tomatoes can also be processed in a pressure canner. For details on using a pressure canner, please refer to UC ANR Publication 8072, *Safe Methods of Canning Vegetables* available free of charge online from http://anrcatalog.ucdavis.edu or follow the canner manufacturer's directions if the canner was purchased after 1990.

Canning tomatoes by non-recommended methods. From time to time, non-recommended, unsafe methods of canning tomatoes arise. One is "open-kettle" canning, a method that was once common in processing tomatoes but which is no longer considered safe. The food is cooked in a deep open pot, quickly put into hot jars, and sealed without further heat processing. Another unsafe method is "oven canning," in which hot, sealed jars of tomatoes are heated in the conventional oven. Heat transfer in an oven is too slow and is insufficient to kill spoilage bacteria. Still another inadequate canning method uses the microwave oven. Not only is this method unsafe, it would also take an extremely long time to process a significant number of jars, and it presents the danger of exploding jars.

CAUTION
Unsafe canning methods include open-kettle canning, oven canning, and microwave canning. Do no can by any of these methods.

Processing at higher altitudes. The processing times given in Table 1 are for altitudes of 0 to 1,000 feet (305 m).

Water bath canner. At higher altitudes, increase the processing time by the following amounts: at 1001 to 3000 feet, add 5 minutes of processing time; at 3001 to 6000 feet, add 10 minutes; and above 6000 feet, add 15 minutes of processing time.

Pressure processing. When processing in a pressure canner at altitudes higher than 1000 feet, process for the basic pressure-canning times but increase the pressure according to the numbers in Table 2. Increases in pressure are necessary to achieve correct processing temperatures.

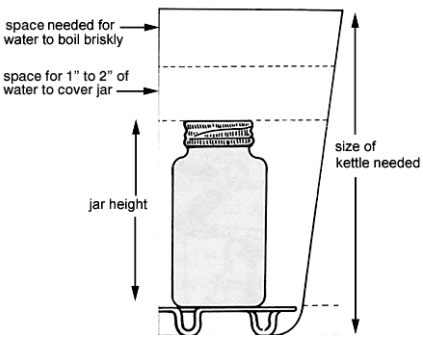


Figure 8. Space needed for adequate water coverage.

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Table 1. Canning tomatoes and tomato products

Product	How to prepare	Processing time *Minutes in boiling water bath (unless pressure canner is indicated)* Pint	Quart
Tomatoes, crushed	Wash tomatoes. Dip in boiling water for about 1 minute or until skins split. Dip in cold water, slip off skins, and remove stem scar. Trim any bruised or discolored portions and quarter. Save juice to add to the tomatoes when heating.		
	Hot pack: Heat about 1 pound of the quarters in a large pot, crushing the tomatoes as they are added. Once tomatoes are boiling, gradually add the remaining quartered tomatoes while stirring. These remaining tomatoes do not need to be crushed. Once all tomatoes have been added, boil gently for 5 minutes. Add commercially bottled lemon juice to each hot jar, 2 tablespoons (30 ml) per quart or 1 tablespoon (15 ml) per pint; or powdered citric acid, ½ teaspoon (2 ml) per quart or ¼ teaspoon (1 ml) per pint. Add salt, if desired, ½ teaspoon to pints or 1 teaspoon to quarts. Pack hot tomatoes into hot jars, leaving a ½ -inch (1cm) head-space. Remove air bubbles, wipe jar rims, adjust lids, and process in a water bath canner.	35	45
	Pressure process: Follow instructions for hot pack. Vent pressure canner for 10 minutes. Begin timing the process when canner has reached 11 pounds pressure (dial gauge pressure canner) or 10 pounds pressure (weighted gauge pressure canner).	15	**15**
Tomatoes, whole or halved, packed in cooking liquid	Wash tomatoes. Dip in boiling water for about 1 minute or until skins split. Dip in cold water, slip off skins, and remove stem scar. Trim any bruised or discolored portions. Save juice to add to the tomatoes when heating.		
	Hot pack: Place whole or halved prepared tomatoes in a large pot and add enough water to barely cover. Bring to a boil and hold for 5 minutes. Add commercially bottled lemon juice to each hot jar, 2 tablespoons (30 ml) per quart or 1 tablespoon (15 ml) per pint; or powdered citric acid, ½ teaspoon (2 ml) per quart or ¼ teaspoon (1 ml) per pint. Add salt, if desired, ½ teaspoon to pints or 1 teaspoon to quarts. Pack hot tomatoes into hot jars, leaving a ½ -inch headspace. Fill jars to ½ inch from the top with hot cooking liquid. Remove air bubbles, wipe jar rims, adjust lids, and process in a water bath canner.	40	45
	Pressure process: Follow instructions for hot pack. Vent pressure canner for 10 minutes. Begin timing the process when canner has reached 11 pounds pressure (dial gauge pressure canner) or 10 pounds pressure (weighted gauge pressure canner).	10	10
Tomatoes, whole or halved, no liquid added	Wash tomatoes. Dip in boiling water for about 1 minute or until skins split. Dip in cold water, slip off the skins, and remove stem scar. Leave whole or cut in half.		
	Raw pack: Add commercially bottled lemon juice to each hot jar, 2 tablespoons (30 ml) per quart or 1 tablespoon (15 ml) per pint; or powdered citric acid, ½ teaspoon (2 ml) per quart or ¼ teaspoon (1 ml) per pint. Add salt, if desired, ½ teaspoon to pints or 1 teaspoon to quarts. Pack tomatoes into hot jars, leaving a ½-inch headspace. Press tomatoes down after each insertion of two tomatoes to release juice and to fill spaces. Remove air bubbles, wipe jar rims, adjust lids, and process in a water bath canner.	85	85
	Pressure process: Follow instructions for raw pack. Vent pressure canner for 10 minutes. Begin timing the process when canner has reached 11 pounds pressure (dial gauge pressure canner) or 10 pounds pressure (weighted gauge pressure canner).	25	25

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Table 1. Canning tomatoes and tomato products (con't)

Product	How to prepare	Processing time *Minutes in boiling water bath (unless pressure canner is indicated)* Pint	Quart
Tomato juice	Wash tomatoes. Dip in boiling water for about 1 minute or until skins split. Dip in cold water, slip off skins, and remove stem scar. Trim any bruised or discolored portions and quarter. Save juice to add to the tomatoes when heating.		
	Hot pack: Use sound, well-ripened, but not overripe tomatoes. Peel, core, and cut into pieces. Cook until soft and strain juice. Juice from cooked tomatoes is thicker and smoother. Press heated tomatoes through a sieve or food mill to remove skins and seeds. Immediately heat juice to simmering. Add commercially bottled lemon juice to each hot jar, 2 tablespoons (30 ml) per quart or 1 tablespoon (15 ml) per pint; or powdered citric acid, ½ teaspoon (2 ml) per quart or ¼ teaspoon (1 ml) per pint. Add salt, if desired, ½ teaspoon to pints or 1 teaspoon to quarts. Fill jars with hot juice, leaving a ½-inch headspace. Wipe jar rims, adjust lids, and process in a water bath canner.	35	40
	Pressure process: Follow instructions for hot pack. Vent pressure canner for 10 minutes. Begin timing the process when canner has reached 11 pounds pressure (dial gauge pressure canner) or 10 pounds pressure (weighted gauge pressure canner).	15	15
Tomato juice cocktail	Wash tomatoes. Dip in boiling water for about 1 minute or until skins split. Dip in cold water, slip off skins, and remove stem scar. Trim any bruised or discolored portions and quarter. Save juice to add to the tomatoes when heating.		
	Hot pack: Extract juice as for tomato juice. Add commercially bottled lemon juice to each hot jar, 2 tablespoons ml) per quart or 1 tablespoon (15 ml) per pint; or powdered citric acid, ½ teaspoon (2 ml) per quart or ¼ teaspoon (1 ml) per pint. Add salt, if desired, 1 teaspoon to pints or 2 teaspoons to quarts. For each quart (1 L), add ½ teaspoon (2 ml) grated onion, 1 teaspoon (5 ml) grated celery, ½ teaspoon (2 ml) prepared horseradish, and ⅛ teaspoon (0.5 ml) Worcestershire sauce. Add hot juice to hot jars to ½ inch from the top. Wipe jar rims, adjust lids, and process in a boiling water bath.	35	40
	Pressure process: Follow instructions for hot pack. Vent pressure canner for 10 minutes. Begin timing the process when canner has reached 11 pounds pressure (dial gauge pressure canner) or 10 pounds pressure (weighted gauge pressure canner).	15	15

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Table 2. Processing pressures for pressure canners at higher altitudes

	Altitude (in feet)				
Type of pressure canner	**0–1,000**	**1,001–2,000**	**2,001–4,000**	**4,001–6,000**	**over 6,000**
	Pressure in pounds per square inch (psi)				
Dial gauge	11	11	12	13	14
Weighted gauge	10	15	15	15	15

Note: Metric conversions:
1,000 feet (ft) = 305 meters
1 pound per square inch (psi) = 6.9 Pascals

QUESTIONS AND ANSWERS

Can I process my own salsa recipe using the processing times in this brochure?

No. Only tested salsa recipes can be canned safely at home. Salsas are usually mixtures of acidic and non-acidic ingredients, so the final acidity may vary depending on the proportions of ingredients. The specific recipe, and sometimes the preparation method, will determine whether a salsa can be processed in a boiling water bath canner or will require processing in a pressure canner. The processing method must be scientifically determined for each recipe.

What are tomatillos? Can I use them like tomatoes?

The tomatillo is related to the tomato, potato, and eggplant. The small, edible tomato-like fruit are green (or sometimes greenish-purple) in color. They are 1 to 3 inches (2.5 to 7.5cm) in diameter and enclosed in papery husks. Tomatillos are often used as a main ingredient in green salsa, and are also added to soups and stews. Tomatillo quality should be judged based on the intensity of green (or purple) color and the freshness of the husk. Once the fruit begin to yellow, their quality goes down. You can generally substitute them for tomatoes, especially green tomatoes. Tomatillo pH values range from 3.9 to 4.1, making it an acidic food.

I've heard that tomatoes are a good source of lycopene. What is it, and what does it do?

Lycopene and beta-carotene are intensely colored carotenoid compounds that act as pigments in some fruits and vegetables. Red tomatoes are especially high in lycopene. Beta-carotene can be converted to Vitamin A in the body. Vitamin A is important for proper vision. Both lycopene and beta-carotene are known as *antioxidants*, which means that they help prevent the destructive action of oxygen on living tissue. Research has shown that lycopene and beta-carotene may help the body resist some types of cancer. A reasonable intake of lycopene has also been shown to decrease the incidence of heart attack.

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RECIPE: Tomato/Green Chili Salsa

Makes 3 pint (500 ml) jars

CAUTION
Wear latex or rubber gloves to protect skin when chopping or handling hot peppers. Avoid touching your face.

Ingredients

3 cups (750 ml)	tomatoes (about 4 medium tomatoes), washed, peeled, cored, and chopped
3/4 cup (175 ml)	onions (about 1 medium onion), finely chopped
3 cups (750 ml)	long green sweet peppers (about 7 medium Anaheim peppers), washed, seeded, and coarsely chopped. Note: Sweet bell peppers may be substituted for long green peppers.
6 cloves	garlic, finely chopped
1 tablespoon (15 ml)	small hot red peppers (about 1 Jalapeno pepper), washed, seeded, and finely chopped
1 1/2 cups (375 ml)	vinegar (at least 5% acetic acid)
1 1/2 teaspoons (7.5 ml)	salt
1/2 teaspoon (2.5 ml)	ground cumin (optional)
2 teaspoons (10 ml)	dried oregano leaves (optional)

Preparation

CAUTION
It is important to follow salsa directions carefully and to use recipes from reliable sources. The following small variations to the recipe can safely be made:
• Other dried herbs or spices may be substituted for the oregano and cumin, so long as the total amount added does not exceed 3 teaspoons (15 ml).

1. Wash hands and work surfaces, and then prepare ingredients.
2. Combine all ingredients in a large saucepan.
3. Bring to a boil, stirring frequently.
4, Reduce heat and simmer 20 minutes, stirring occasionally.
5. Ladle salsa hot into pint jars, leaving a 1/2-inch (1 cm) headspace.
6. Wipe rims of jars with a dampened clean paper towel and apply two-piece metal canning lids.
7. Process 15 minutes in a water bath canner at altitudes up to 1000 feet. Above 1000 feet, increase processing time by 1 minute for every additional 1000-foot increase in altitude.
8. Let jars cool undisturbed for 12 to 24 hours, then check seals.

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RECIPE: Tomato/Tomato Paste Salsa

Makes 7 pint (500 ml) jars

CAUTION
Wear latex or rubber gloves to protect skin when chopping or handling hot peppers. Avoid touching your face.

Ingredients

3 quarts (3 L)	tomatoes (about 12 medium tomatoes), washed, peeled, cored, and chopped
3 cups (750 ml)	onions (about 3 medium onions), chopped
1 1/2 cups (375 ml)	long green sweet peppers (about 4 Anaheim peppers), washed, seeded, and chopped. Note: Sweet bell peppers may be substituted for long green peppers.
6 tablespoons *(1/4 cup + 2 tablespoons)* (90ml)	small hot red peppers (about 6 Jalapeno peppers), washed, seeded, and finely chopped
4 cloves	garlic, finely chopped
2 12-oz cans *(2 340-g cans)*	tomato paste
2 cups (500 ml)	commercially bottled lemon juice
1 tablespoon (15 ml)	salt
1 tablespoon (15 ml)	sugar
1 tablespoon (15 ml)	ground cumin (optional)
2 tablespoons (30 ml)	oregano leaves (optional)
1 teaspoon (5 ml)	black pepper

Preparation

1. Wash hands and work surfaces, and then prepare ingredients.
2. Combine all ingredients in a large saucepan.
3. Bring to a boil, stirring frequently.
4, Reduce heat and simmer 30 minutes, stirring occasionally.
5. Ladle hot into pint jars, leaving a 1/2-inch (1 cm) headspace.
6. Wipe rims of jars with a dampened clean paper towel and apply two-piece metal canning lids.
7. Process 15 minutes in a water bath canner at altitudes up to 1000 feet. Above 1000 feet, increase processing time by 1 minute for every additional 1000-foot increase in altitude.
8. Let jars cool undisturbed for 12 to 24 hours, then check seals.

CAUTION
It is important to follow salsa directions carefully and to use recipes from reliable sources. The following small variations to the recipe can safely be made:
• Other dried herbs or spices may also be substituted for the oregano and cumin, so long as the total amount added does not exceed 3 tablespoons (45 ml).

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ADDITIONAL RESOURCES

About Produce.com is a Web page maintained by the Produce Marketing Association. It gives extensive information about produce, including recipes and nutritional information.
http://www.aboutproduce.com

The UCFoodSafety Web Site at UC Davis provides information about food safety and has links to resources on home food preservation.
http://www.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 Postharvest Technology Research and Information Center at UC Davis provides information on storing fresh fruits and vegetables, including the publication *Storing Fresh Fruits and Vegetables for Better Taste*.
http://postharvest.ucdavis.edu/pubs/index.shtml#homestorage

University of Georgia College of Family and Consumer Sciences, Food Safety and Preservation section provides an extensive list of publications on preserving food safely, as well as other food-related information.
http://www.fcs.uga.edu/extension/food_pubs.php

Vegetable Research and Information Center at UC Davis has information on growing vegetables in the home garden.
http://vric.ucdavis.edu/veginfo/homegarden.htm

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FOR MORE INFORMATION

You'll find detailed information on many aspects of food preservation and preparation in these titles and in other publications, slide sets, CD-ROMs, and videos from UC ANR:

Cantaloupe: Safe Methods to Store, Preserve, and Enjoy, publication 8095

Peppers: Safe Methods to Store, Preserve, and Enjoy, publication 8004

Safe Methods of Canning Vegetables, publication 8072

To access these and other 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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e-mail inquiries: danrcs@ucdavis.edu

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