

## Objectives

- To provide general directions for preparing foods for drying.
- To provide general directions for drying foods and making safe jerky.
- To provide specific directions for the preparation and drying of fruits and vegetables.

## Introduction

Drying or dehydration—the oldest method of food preservation—is particularly successful in the hot, dry climates found in much of New Mexico. Quite simply, drying removes moisture from food, and moisture is necessary for the bacterial growth that eventually causes spoilage. Successful dehydration depends upon a slow, steady heat supply to ensure that food is dried from the inside to the outside. Most fruits and vegetables must be prepared by blanching—and in some cases by adding preservatives—to enhance color and microbial shelf-life of the dried food. However some fruits, such as berries, are not blanched before drying. Drying is an inexact science. Size of food pieces, relative moisture content of the food, and the method selected all affect the time required to dehydrate a food adequately.

## General Directions for Preparing Foods for Drying

### Safe handling procedures

- Always wash hands thoroughly with soap and running water for at least 20 seconds before and after handling raw meats, fruits, and vegetables.
- Use clean equipment and utensils.
- Keep meat and produce refrigerated at 40°F or below.

Refer to Tables 1 and 2 for instructions for specific foods.



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### Blanching

Blanching stops detrimental enzyme action within the plant tissue and also removes any remaining surface bacteria and debris. Blanching breaks down plant tissue so it dries faster and rehydrates more quickly after drying. Although steam blanching and water blanching are both discussed in this guide, water blanching is preferred to steam blanching. Fully immersing the food in boiling water will ensure a complete heat treatment. Blanch for the required time (Tables 1 and 2), then chill food quickly in an ice bath to stop any further cooking.

To blanch in boiling water, use one gallon of boiling water per pound of food. Immerse food in the boiling water using a wire basket or mesh bag, cover the pot, and boil for the recommended time (see Tables 1 and 2). Drain food thoroughly. Blanching water can be reused until it becomes cloudy.

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Table 1. Preparation Instructions for Drying Vegetables in Modern Electric Dehydrators					
Vegetable	Preparation	Blanching time <sup>1</sup> (min.)		Hours of drying time	Dryness test <sup>2</sup>
		Steam	Water		
Asparagus	Wash thoroughly. Halve large spears.	4–6	4–5	6–10	Leathery to brittle
Beans, green	Wash. Cut into pieces or strips.	2–3	4	8–14	Very dry, brittle
Beets	Cook as usual. Cool, then peel. Cut into shoestring strips 1/8 inch thick.	Included in cooking.		10–12	Brittle, dark red
Broccoli	Trim, cut as for serving. Wash. Quarter stalks lengthwise.	3–4	4	12–15	Crisp, brittle
Brussels sprouts	Cut in half lengthwise through stem.	7–8	5–6	12–18	Tough to brittle
Cabbage	Remove outer leaves, then quarter and core. Cut into strips 1/8 inch thick.	3	4	10–12	Crisp to brittle
Carrots, parsnips	Select crisp, tender vegetables. Wash. Cut off roots and tops. Peel. Cut into slices or strips 1/8 inch thick.	3–4	4	6–10	Tough to brittle
Cauliflower	Prepare as for serving.	5–6	4–5	12–15	Tough to brittle
Celery	Trim stalks. Wash stalks and leaves thoroughly. Slice stalks.	2–3	4	10–16	Very brittle
Chile peppers, green	Wash. To loosen skins, cut slit in skin, then rotate over flame 6–8 min. or scald in boiling water. Peel and split pods. Remove seeds and stem. (Wear gloves if necessary.)	None	None	4–8	Crisp, brittle, medium green
Chile peppers, red	Wash. String whole pods together with needle and cord or suspend in bunches, stem side up, in area with good air circulation.	None	None	4–8	Shrunken, dark red pods, flexible
Corn, cut	Prepare as for corn on the cob, except cut the kernels from the cob after blanching.	3–5	4–6	6–10	Brittle
Corn, on the cob	Husk, trim, blanch until milk in corn is set.	3–5	4–6	6–10	Brittle
Eggplant	Wash, trim, cut into 1/4-inch slices.	3–4	3–4	12–14	Leathery to brittle
Horseradish	Wash, remove small roots and stubs. Peel or scrape roots. Grate.	None	None	6–10	Brittle, powdery
Mushrooms <sup>3</sup>	Scrub. Discard tough, woody stalks. Slice tender stalks 1/4 inch thick. Peel large mushrooms, slice. Leave small mushrooms whole.	None	None	8–12	Dry and leathery
Onions	Wash, remove outer skin. Remove tops and root ends, slice 1/8 to 1/4 inch thick.	None	4	8–10	Very brittle
Parsley and other herbs	Wash thoroughly. Separate clusters. Discard long or tough stems. Dry on trays or hang in bundles in area with good air circulation.	None	4	4–6	Flaky
Peas	Shell.	3–4	4	8–10	Hard, wrinkled, green
Peppers and pimentos	Wash, stem, remove core and seeds. Cut into 1/4- to 1/2-inch strips or rings.	None	4	8–12	Tough to brittle
Potatoes	Wash, peel. Cut into 1/4-inch shoestring strips or 1/8-inch slices.	7–9	6–7	6–10	Brittle
Spinach and other greens (kale, chard, mustard)	Trim and wash very thoroughly. Shake or pat dry to remove excess moisture.	2–3	4	6–10	Crisp
Squash, summer or banana	Wash, trim, cut into 1/4-inch slices.	3	4	10–16	Leathery to brittle
Squash, winter	Cut or break into pieces. Remove seeds and cavity pulp. Peel rind. Cut into 1-inch wide strips. Cut strips crosswise into pieces about 1/8 inch thick.	3	4	10–16	Tough to brittle
Tomatoes	Steam or dip in boiling water to loosen skins. Chill in cold water. Peel. Slice 1/2 inch thick or cut into 3/4-inch sections.	None	None	6–24	Crisp
<sup>1</sup> Blanching times are for elevations of 3,000–5,000 ft. Times will be slightly longer at higher elevations, or if the quantity of vegetable is large.					
<sup>2</sup> Dry in thin layers on trays to desired state of dryness.					
<sup>3</sup> <b>WARNING: The toxins of poisonous varieties of mushrooms are not destroyed by drying or by cooking. Only an expert can tell the difference between poisonous and edible varieties.</b>					

Table 2. Preparation Instructions for Drying Fruits in Modern Electric Dehydrators			
Fruit	Preparation	Pretreatment	Drying procedure
Apples (mature, firm)	Wash. Pare (if desired) and core. Cut into rings or slices 1/8 to 1/4 inch thick or cut into quarters or eighths. Coat with ascorbic acid solution to prevent darkening during preparation (see <i>Selecting and preparing fruit</i> section).	Choose one: <ul style="list-style-type: none"> <li>• Soak 5 min. in a dip solution, depending on size and texture.</li> <li>• Steam blanch 3–5 min., depending on size and texture.</li> </ul>	Arrange in single layer on trays, core side up. Dry until soft, pliable, and leathery; no moist area in center when cut.
Apricots (firm, fully ripe)	Wash. Cut in half and remove pit, but do not peel. Coat with ascorbic acid solution to prevent darkening during preparation (see <i>Selecting and preparing fruit</i> section).	Choose one: <ul style="list-style-type: none"> <li>• Soak 5 min. in a dip solution.</li> <li>• Steam blanch 3–5 min.</li> </ul>	Arrange in single layer on trays, pit side up; pop the cavity up to expose more flesh to air. Dry until soft, pliable, and leathery; no moist area in center when cut.
Bananas (firm, ripe)	Peel. Cut into 1/8-inch slices.	No pretreatment necessary, but you may choose to dip in lemon juice.	Arrange in single layer on trays. Dry until tough and leathery.
Berries (firm)	Wash. Leave whole or cut in half.	No pretreatment necessary, but you may choose to <ul style="list-style-type: none"> <li>• Crack skins by dipping in boiling water for 15–30 sec.</li> <li>• Steam blanch 30–60 sec.</li> </ul>	Spread in layer not more than two berries deep. Dry until hard and berries rattle when shaken on trays.
Cherries (fully ripe)	Wash. Remove stems and pits.	No pretreatment necessary, but you may choose to dip whole cherries in boiling water 15–30 sec. to crack skins.	Arrange in single layer on trays. Dry until tough, leathery, and slightly sticky.
Citrus peel (thick-skinned with no signs of mold or decay and no color added)	Wash. Thinly peel outer 1/16 to 1/8 inch of the peel; avoid white bitter part.	No pretreatment necessary.	Arrange in single layers on trays. Dry at 130°F for 1–2 hours, then 120°F until crisp.
Figs (fully ripe)	Wash or clean with damp towel. Peel dark-skinned varieties if desired. Leave whole if small or partly dried on tree; cut large figs into halves or slices.	No pretreatment necessary, but you may choose to crack skins of whole figs by dipping in boiling water for 15–30 sec.	Arrange in single layer on trays. Dry until leathery and pliable.
Grapes and black currants (seedless varieties)	Wash and sort. Leave whole on stems in small bunches, if desired; can also remove stems.	No pretreatment necessary, but you may choose to <ul style="list-style-type: none"> <li>• Crack skins by dipping in boiling water for 15–30 sec.</li> <li>• Steam blanch 1 min.</li> </ul>	Spread in thin layer on trays. Dry until pliable and leathery with no moist center.
Melons (mature, firm, and heavy for size; cantaloupe dries better than watermelon)	Wash. Remove outer skin, any fibrous tissue, and seeds. Slice 1/4 to 1/2 inch thick.	No pretreatment necessary.	Arrange in single layer on trays. Dry until leathery and pliable with no pockets of moisture.
Nectarines and peaches (ripe, firm)	Peel. Cut in half and remove pit. Cut into quarters or slices if desired. Coat with ascorbic acid solution to prevent darkening during preparation (see <i>Selecting and preparing fruit</i> section)	Choose one: <ul style="list-style-type: none"> <li>• Soak 5–15 min. in a dip solution</li> <li>• Steam blanch halves 8–10 min, slices 2–3 min.</li> </ul>	Arrange in single layer on trays pit side up. Turn halves over when visible juice disappears. Dry until leathery and somewhat pliable.
Pears (Bartlett variety is recommended)	Wash. Pare if desired. Cut in half lengthwise and core. Cut into quarters or eighths or slice 1/8 to 1/4 inch thick. Coat with ascorbic acid solution to prevent darkening during preparation (see <i>Selecting and preparing fruit</i> section).	Choose one: <ul style="list-style-type: none"> <li>• Soak 5–15 min. in a dip solution</li> <li>• Steam blanch 5–7 min.</li> </ul>	Arrange in single layer on trays pit side up. Dry until springy and leathery with no pockets of moisture.
Plums and prunes	Wash. Leave whole if small; remove pits from large fruit and cut into halves or slices.	No pretreatment necessary, but you may choose to <ul style="list-style-type: none"> <li>• Steam blanch halves or slices 5–7 min.</li> <li>• Crack skins by dipping in boiling water for 1–2 min.</li> </ul>	Arrange in single layer on trays pit side up, cavity popped out. Dry until pliable and leathery; pit should not slip when squeezed if prune not cut.



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To steam blanch, place 1 inch of water in a pot and bring to a rolling boil. Use a basket or a loose cheesecloth bag to suspend a thin layer of food in the pot (so the food is not touching the water). Cover and steam blanch for the required amount of time (see Tables 1 and 2).

### Selecting and preparing vegetables

Choose tender vegetables. Wash, remove any damaged areas, and cut into even-sized pieces or slices (Table 1).

### Selecting and preparing fruit

Choose firm, mature fruit. Wash, peel if desired, remove any damaged areas, and cut into even-sized pieces or slices (Table 2). Some fruits require little or no pretreatment. However, apples, apricots, bananas, cherries, peaches, and pears can be pretreated in a dip solution described below to reduce vitamin and flavor loss, browning, and deterioration during storage.

- Dip solution made from commercial ascorbic acid powder mixed in water. Follow manufacturer's instructions when preparing and using the solution.
- Dip solution made by dissolving ascorbic acid (vitamin C) pure crystals in water. Stir 2 1/2 tablespoons (34 grams) of pure ascorbic acid crystals into one quart (1 liter) of cold water. If pure ascorbic acid is not available, you can use crushed vitamin C tablets; six 500-milligram tablets equal one teaspoon of ascorbic acid, so 45 500-milligram tablets will be enough

for one quart of solution. One quart of ascorbic acid solution will treat about 10 quarts of cut fruit. Allow cut fruit to soak in solution for ten minutes.

- Dip solution made with citric acid or lemon juice. Prepare the citric acid solution by stirring 1 teaspoon (5 grams) of citric acid into one quart (1 liter) of cold water. For the lemon juice solution, mix equal parts lemon juice and cold water (e.g., 1 cup lemon juice and 1 cup water). Soak cut fruit for ten minutes in solution. Citric acid is often available in the canning section of the supermarket.
- Dip solution utilizing either 1 tablespoon of sodium bisulfite, 2 tablespoons of sodium sulfite, or 4 tablespoons of sodium metabisulfite per quart of water. These pretreatment mixtures are available online or from specialty homebrewing or winemaking shops. Soak fruit pieces for 5 minutes and fruit halves for 15 minutes **Note: Approximately 5% of asthmatics are sensitive to sulfites.**

### Selecting and preparing meat

Good quality, lean cuts of beef, pork, or venison are best for drying meat. Goat and lamb can also be dried but tend to have strong flavors that are intensified by drying. To prepare meats, first remove all visible fat. Freeze the meat, then allow it to thaw slightly before slicing.

### Methods of Drying

Foods may be sun-dried with or without a solar dehydrator, dried in a gas or electric oven, or dried with a portable electric dehydrator. Dehydrators with thermostats are not affected by weather conditions and allow better control over food quality than sun drying. Clotheslines are an acceptable drying rack for ears of corn. Colorful red chile ristras hung from vigas are practical as well as decorative.

### Sun drying

The high sugar and acid content of fruit makes them safe for sun drying. Vegetables (with the exception of vine-dried beans) and meats are not recommended for sun drying. It is best to dry meats and vegetables indoors using the controlled conditions of an oven or food dehydrator.

Dry fruit on hot, dry, breezy days with a minimum temperature of 85°F—the hotter the day the better. Relative humidity should be below 60%. Because the weather is uncontrollable, sun-drying fruit can be risky, and it can take several days to complete the process. Often,



ideal conditions are not available when the fruit ripens, and an alternative method of drying the food is needed. Sun-dried fruit must be covered or brought under shelter at night. Cool night air condenses, which adds moisture back to the food and slows the drying process.

Place prepared foods on drying trays. Stainless steel screening and thin wood lath are good materials for home-constructed drying trays. Since aluminum screening reacts with acids in the fruit, it is less desirable. Do not use galvanized metal, copper, fiberglass, or vinyl screening. Trays measuring about 14 in. × 24 in. × 1 in. are an easy size to handle. Place trays of food away from dusty roads and yards. Elevate them at least 1 inch above the table with spools or bricks to allow good air circulation below the food (Figure 1). Cover the food with a muslin or cheesecloth tent to protect it from insects. Dry fruit in direct sunlight; move trays periodically to ensure direct sun exposure. If weather turns rainy, you will have to complete the drying process using another method. Heat all sun-dried foods in a 150°F oven for 30 minutes to destroy insects or insect eggs, which may be present on sun-dried foods, and to remove additional moisture in thicker pieces.

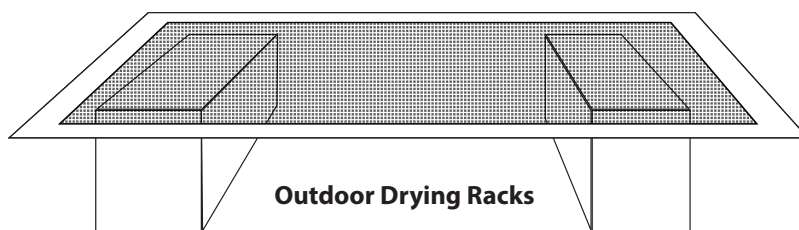
### Oven drying

Trays for oven drying can be built as described for sun drying; trays for oven drying should be 1 1/2 inches smaller in length and width than oven racks to allow air circulation. Or, convert oven racks to drying racks by stretching muslin or cheesecloth across the rack. Secure the cloth with toothpicks or long sewn stitches. To ensure even drying in the oven, rotate trays top to bottom halfway through drying time. Set the oven at its lowest temperature setting, but not below 140–150°F. Moisture from drying food must be released from the oven. A gas oven should have a vent that will allow moisture to escape. However, electric ovens must be vented by keeping the door open at least one inch, which can be done by wedging a potholder between the door and oven.

### Dehydrator

There are two types of dehydrators: solar and electric. For each type of dehydrator, prepare food and place on racks. If using a solar dehydrator, adjust the position of the food throughout daylight hours to keep it in direct sunlight.

Follow manufacturer's instructions for electric dehydrators. When purchasing an electric dehydrator, select one that has a thermostat to regulate temperature and a fan to circulate air.



## Solar Drying

*Figure 1. Sun-drying racks. (Source: National Center for Food Preservation.)*

### Drying Times

Drying time varies widely depending on the drying method selected and the size and amount of moisture in food pieces. Sun drying requires the most time; an electric dehydrator requires the least. Vegetables take from 4 to 12 hours to dry; fruits take 6–20 hours; meats require about 12 hours. Making raisins from grapes may require days or weeks when drying is done outside. When testing foods for dryness, remove a piece from the center of the drying tray and allow it to come to room temperature. Fruit and meat jerky should be leathery and pliable; vegetables should be brittle.

### Conditioning Dried Foods

Food should be conditioned for a week before being packaged for long-term storage. To condition food, place it in a container such as a cloth sack or a clear, covered container. Conditioning allows any remaining moisture to redistribute itself throughout the food.

Watch for moisture beads on containers. If they form, continue drying food. If using a cloth bag, hang it in a convenient location and shake the bag daily to redistribute food and moisture.

### Storing Dried Foods

Place dried food in freezer-weight plastic storage bags, press out air, and put the bags in containers with tight-fitting lids. Store in a cool, dark, dry area.

Dried foods store well at room temperature for a month. Refrigerate foods if they will be used within three months. Dried foods should be frozen if they will be used between three months and one year. Foods should be used within one year.

## Using Dried Foods

Dried meat, commonly called jerky, is normally not rehydrated and is eaten in the dried state, but can be soaked in water similar to dried vegetables and used in stew or soup.

Dried vegetables used in soups rehydrate during the cooking process. Vegetables can also be rehydrated by soaking them in 1 1/2 to 2 cups of water per cup of dried vegetable. If necessary, add more water during the soaking process.

To rehydrate dried fruit, cover it with boiling water, let stand for 5 minutes, and drain. Dried fruit may also be steamed for 3–5 minutes until plump. Fruit may be eaten immediately or used in a recipe.

## Nutritional Value of Dried Foods

Dried foods retain their protein, mineral, and vitamin A content fairly well. When rehydrating dried foods for consumption, consume the soaking water as well since it will contain some of these nutrients. Because they are concentrated into a small mass, dried foods can also be high in calories. It's important to brush your teeth after eating dried fruits because they stick to the teeth.

## Making Fruit Leather

Fruit leathers, also called fruit roll ups, can be made from almost any fruit or combinations of fruits. Strawberries are the most common, but peaches, apricots, cherries, and nectarines are also ideal. Applesauce by itself or added to other fruit makes wonderful fruit leather. Wash fruit well, peel (if desired), cut into pieces, and purée fruit in a blender. Sweeten to taste with sugar or honey. Spread evenly, no more than 1/4 inch deep, on a cookie sheet. The cookie sheet should either be lightly sprayed with a cooking spray or covered with plastic wrap. If using plastic wrap, tape edges down to prevent them from folding into the purée.

### Oven drying

Set your oven at the lowest setting (140–145°F). Place the trays of purée on the oven rack and leave the door open 2 to 6 inches, depending on the oven door. Use a thermometer to check the oven temperature. The fruit purée should dry in 4 to 10 hours. Test frequently for dryness (see *Test for dryness* section).



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### Dehydrator drying

Place sheets or trays of fruit purée in the dehydrator. Set the temperature control at 140–145°F, or follow manufacturer's directions. Drying time will be 4 to 10 hours. Test frequently for dryness.

### Test for dryness

Properly dried fruit leather will be translucent and slightly tacky to the touch but easily peeled from the pan or plastic wrap. Touch the leather in several places; this should not leave any indentations. Lift the edge of the leather, which will adhere tightly to the surface, and peel it back about an inch. If it peels readily, it is properly dried. If the leather has cooled, it may need to be warmed in an oven at 150°F for a few minutes to help it peel away more easily. If the leather cracks or chips, it has dried for too long, but is still edible. When dried, lift leather (including plastic wrap if used) and roll, or cut into small sections and roll. Storage recommendations are the same as those described previously for other dried food.

## Making Safe Jerky

Homemade jerky has been identified as the cause of a foodborne illness outbreak in the West. The small electric dehydrator that was used hadn't reached a high enough temperature to kill harmful bacteria.

*E. coli* 0157:H7 bacteria can grow in the intestines of animals and contaminate meat during handling. To kill these bacteria, jerky must be heated to 160°F while it is still moist. Modern home dehydrators can reach 160°F, but many older home dehydrators are not designed to reach

this temperature, and the jerky must be heated in another way to guarantee safety. This can be done by precooking.

Precooking in marinade shortens the drying time and makes a tender jerky. Although it will be different from conventional jerky in color and texture, precooked jerky is still very tasty. This method is currently recommended by the Meat and Poultry Hotline (1-888-674-6854) of the U.S. Department of Agriculture (USDA). Visit [http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/meat-preparation/jerky-and-food-safety/CT\\_Index](http://www.fsis.usda.gov/wps/portal/fsis/topics/food-safety-education/get-answers/food-safety-fact-sheets/meat-preparation/jerky-and-food-safety/CT_Index) for more information.

**Note: Research is needed to identify other safe jerky-making procedures. To date, there is no safe procedure for the dry cure method. Use the following procedure to precook in boiling water or marinade, then add dry spices to meat slices placed on dryer racks.**

### To precook jerky

1. Freeze meat before preparing so that it will be easier to slice.
2. Cut partially frozen meat into long slices that are no more than 1/4 inch thick. For tender jerky, cut at a right angle to long muscles ("across the grain"). To prevent off-flavors, remove as much of the fat as possible.
3. Prepare 1–2 cups of marinade of your choice in a large saucepan. Here is a simple marinade recipe:
  - 1 teaspoon garlic salt
  - 2 cups soy sauce
  - 1 teaspoon coarse black pepper

**Caution: Soaking the meat strips in marinade overnight is not advised. Bacteria will be spread in the kitchen when the marinated strips are drained before precooking. Putting un-marinated strips directly into boiling marinade minimizes a cooked flavor and maintains safety.**

4. Bring the marinade to a full rolling boil over medium heat. Add a few meat strips, making sure that they are covered by marinade. Re-heat to a full boil.

5. Remove the pan from the stovetop. Using tongs, immediately remove meat from the hot marinade to prevent over-cooking.

Repeat steps 4 and 5 until all meat has been precooked. Add more marinade if needed

6. Place precooked strips in single non-overlapping layers on drying racks.
7. Dry in a dehydrator or oven. Use a calibrated thermometer to monitor the circulating air temperature of the dehydrator or oven. Pre-heat the dehydrator or oven to 145°F for 15–30 minutes. Place the filled trays in the preheated dehydrator, leaving enough open space on the racks for air to circulate around the strips. Let the strips dry for 10 to 14 hours, or until the pieces are adequately dry.

### Test for doneness

Properly dried jerky is chewy and leathery. It will be as brittle as a green stick, but won't snap like a dry stick. Test by letting a piece cool. When cool, it should crack but not break when bent. There should not be any moist or underdone spots.

Refrigerate the jerky overnight in a plastic freezer bag, then check again for doneness. If necessary, dry further. **Keep jerky in the refrigerator or freeze for long-term storage.**

### References:

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