

## 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 fruit 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 deterioration. Successful dehydration depends upon a slow steady heat supply to ensure that food is dried from the inside to the outside. Before food is dried it must be prepared by blanching—and in some cases by adding preservatives—to enhance color and microbial shelf-life of the dried food. Drying is an inexact science. Size of pieces, relative moisture, 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, fruit and vegetables.
- Use clean equipment and utensils.
- Keep meat and produce refrigerated at 40°F or below.

Refer to the tables at the end of this guide for instructions for specific foods.

**Blanch.** Blanching stops detrimental enzymatic action within the plant tissue and also removes any remaining surface bacteria and debris. Blanching breaks down plant tissue so it dries faster and re-hydrates more

quickly after drying. Although both methods of blanching are given in this document, water blanching is preferred to steam blanching. Fully immersing the food in boiling hot water will ensure a complete heat treatment. Blanch, then chill 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 vegetables in the boiling water using a wire basket or mesh bag, cover kettle, and boil for the recommended time (see Table 1). Blanching water may be reused until it becomes cloudy. Drain fruit or vegetables thoroughly.

To steam blanch, place 1 inch of water in kettle and bring to a rolling boil. Suspend a thin layer of vegetables in a basket or a loose cheesecloth bag. Cover and steam blanch for the required amount of time (see Table 1). Steam blanch fruit for 5–6 minutes; water blanch fruit for 4–5 minutes.

**Vegetables.** Choose tender vegetables. Wash, remove any damaged areas, and cut into even pieces.

**Fruit.** Choose firm, mature fruit. Wash, peel if desired, remove any damaged areas, and cut into even-sized pieces or slices. Some fruits require little or no pre-treatment. However, pre-treat apples, apricots, bananas, cherries, peaches, and pears to reduce vitamin and flavor loss, browning, and deterioration during storage.

Immerse fruit in a solution of one of the following to a gallon of water: 1 tbsp of sodium bisulfite or 2 tbsp of sodium sulfite or 4 tbsp of sodium metabisulfite. These pretreatment mixtures are available from some grocery stores, pharmacies, and winemaking shops. Soak fruit pieces for 5 minutes and fruit halves for 15 minutes.

**Note: Approximately 5% of asthmatics are sensitive to sulfites. Use one of the following pretreatments if sulfites present a potential health problem:**

- Dip fruit in a commercial ascorbic acid/water mixture from the grocery store. Follow manufacturer's instructions when preparing and using the solution.
- Dip prepared fruit in a saline solution composed

of 2–4 tbsp of salt and one gallon of water for 10–15 minutes.

**Meat.** Choose good quality lean cuts of beef or venison. Freeze and remove all visible fat.

## METHODS OF DRYING

Foods may be sun-dried with or without a solar dehydrator, or dried in a gas or electric oven or with a portable electric dehydrator. Dehydrators with thermostats are not affected by weather conditions and allow better control over food quality than sun-drying does. 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.** Fruits' high sugar and acid content make 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 percent. 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, adding moisture back to the food, thus slowing the drying process.

Prepared foods are placed on drying trays. Stainless steel screening and thin wood lath are good materials for home-constructed drying trays. As aluminum screening reacts with acids in the fruit, it is less desirable. Do not use galvanized, copper, fiberglass, or vinyl screening. Trays measuring about 14 in. x 24 in. x 1 in. are an easy size to handle. If trays are to be used in an oven, they should be 1 1/2 inches smaller in length and width than oven shelves to allow air circulation. 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. 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 sun-dried foods in a 150°F oven for 30 min to destroy insects or insect eggs, which may be present on sun-dried foods, and to remove additional moisture in thicker pieces.

**Oven drying.** Either build trays as described for sun-drying or convert oven racks to drying racks by stretching muslin or cheesecloth across the oven rack. Secure with toothpicks or long sewn stitches. To ensure even drying in the oven, alternate the trays. Set oven control at its lowest 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 pot holder 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. See Figure 1 for a diagram of a solar tray.

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

## DRYING TIMES

Drying time varies widely depending on the 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; fruit 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 and allowing any remaining moisture to redistribute itself through the fruit.

Watch for moisture beads on containers. If they form, continue drying food. If using the 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, then 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; freeze foods for storage periods between three months and one year. Foods should be used within one year.

## USING DRIED FOODS

Dried meat, commonly called jerky, is normally not re-hydrated and is eaten in the dried state. Dried vegetables used in soups re-hydrate during the cooking process.

Re-hydrate vegetables by soaking them in 1 1/2–2 cups of water per cup of dried vegetable. If necessary, add more water during the soaking process. **Heat and eat.**

Cover dried fruit with boiling water and let stand for 5 minutes. Drain. Dried fruit may also be steamed for 3–5 minutes until plump. Fruit may be eaten immediately or used in a recipe.

## MAKING FRUIT LEATHER

Fruit leathers, also called fruit roll ups, can be made from almost any fruit or combinations of fruits. However, peaches, apricots, cherries, and nectarines are ideal. Pears and apples, sufficiently softened, also work well. Wash well, peel (if desired), cut into pieces, and puree 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 vegetable shortening or covered with plastic wrap. If using plastic wrap, tape edges down to prevent them from folding into the puree.

**Oven Drying.** Set oven at the lowest setting (140° to 145°F). Place the trays of puree 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 puree should dry in 4 to 10 hours. Test frequently for dryness (see test for dryness).

**Dehydrator drying.** Place sheets or trays of fruit concentrate in the dehydrator. Set temperature control at 140° to 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 paper if used) and roll or cut into small sections and roll. Storage recommendations are the same as those described previously for other dried food.

## NUTRITIONAL VALUE OF DRIED FOODS

Dried foods retain their protein, mineral and vitamin A content fairly well. If rehydrating dried foods for consumption, consume the soaking water as well, as 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 teeth after eating dried fruit because they stick to the teeth.

## MAKING SAFE JERKY

Home-prepared jerky was recently 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. Because most home dehydrators are not designed to reach this temperature, 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, pre-cooked jerky is still very tasty. This method is currently recommended by the Meat and Poultry Hotline (1-800-535-4555) of the U.S. Department of Agriculture (USDA).

**Note: Research is needed to identify other safe jerky-making procedures. To date, there is no safe procedure for the dry cure method.**

### To precook jerky

1. Freeze meat before preparing so that it will be easier to slice.
2. Cut partially thawed 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.

**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 range. Using tongs, immediately remove meat from the hot marinade to prevent over-cooking.

Here is a simple marinade recipe:

- 1 teaspoon garlic salt
- 2 cups soy sauce
- 1 teaspoon coarse black pepper

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

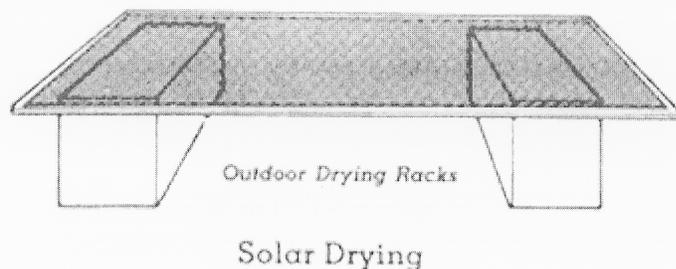
6. Place precooked strips in single non-overlapping layers on drying racks.
7. Dry in a dehydrator or oven. Use a calibrated thermometer to monitor the circulating air temperature of the dehydrator or oven. Pre-heat the dehydrator or oven to 145°F for 15 to 30 minutes. Place the filled trays in the preheated 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.

8. 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.**



**Figure 1. Sun-drying racks.**

**National Center for Food Preservation. Solar Drying.**

#### **References:**

- Kendall, P. & Sofos, J. (2003) Leathers and jerkies (No. 9.311). Cooperative Extension Service, Colorado State University Available from: [www.ext.colostate.edu](http://www.ext.colostate.edu)
- Andress, E.L & Harrison, J. A., Eds. 2006. So easy to preserve, (Bulletin 989, 5th ed.). Cooperative Extension Service, University of Georgia, Athens. Available from <http://www.uga.edu/nchfp/>

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| Vegetable            | Preparation   | Blanching Time <sup>1</sup><br>(min.) |       | Hrs Dry<br>Time | Dryness test <sup>2</sup>         |
|----------------------|---|---------------------------------------|-------|-----------------|-----------------------------------|
|                      |   | Steam                                 | Water |                 |                                   |
| Asparagus            | Wash thoroughly. Halve large tips.  | 4–6                                   | 4–5   | 6–10            | Leathery to brittle               |
| Beans, green         | Wash. Cut in pieces or strips.  | 2–3                                   | 4     | 8–14            | Very dry, brittle                 |
| Beets                | Cook as usual. Cool, peel. Cut into shoestring strips 1/8" 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, quarter and core. Cut into strips 1/8" thick.  | 3                                     | 4     | 10–12           | Crisp to brittle                  |
| Carrots, parsnips    | Select crisp, tender vegetables. Wash. Cut off roots and tops; peel. Cut in slices or strips 1/8" 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  | 12–24           | Crisp, brittle, medium green      |
| Chile peppers, red   | Wash. String whole pods together with needle and cord or suspend in bunches, root side up in area with good air circulation.  | None                                  | None  | 12–24           | Shrunken, dark red pods, flexible |

<sup>1</sup> Blanching times are for 3,000–5,000 ft. Times will be slightly longer at higher altitudes, or if the quantity of vegetable is large.

<sup>2</sup> Dry in thin layers on trays to desired state of dryness.

| Vegetable                                       | Preparation   | Blanching Time <sup>1</sup><br>(min.) |       | Hrs Dry<br>Time | Dryness test <sup>2</sup> |
|---|---|---------------------------------------|-------|-----------------|---------------------------|
|   |   | Steam                                 | Water |                 |                           |
| Corn-on-the cob                                 | Husk, trim, blanch until milk in corn is set.   | 3–5                                   | 4–6   | 6–10            | Brittle                   |
| 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                   |
| Eggplant  | Wash, trim, cut into 1/4" 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" thick. Peel large mushrooms, slice. Leave small mushrooms whole.   | None                                  | None  | 8–12            | Dry and leathery          |
| Onions  | Wash, remove outer "paper shells." Remove tops and root ends, slice 1/8" – 1/4" 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 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"–1/2" strips or rings.  | None                                  | 4     | 8–12            | Tough to brittle          |
| Potatoes  | Wash, peel. Cut into 1/4" shoe-string strips or 1/8"–thick 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                     |

<sup>1</sup> Blanching times are for 3,000–5,000 ft. Times will be slightly longer at higher altitudes, 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> **WARNING: The toxins of poisonous varieties of mushrooms are not destroyed by drying or by cooking. Only an expert can differentiate between poisonous and edible varieties.**

| Vegetable                | Preparation  | Blanching Time<br>(min.) |       | Hrs Dry<br>Time | Dryness test        |
|--------------------------|--|--------------------------|-------|-----------------|---------------------|
|                          |  | Steam                    | Water |                 |                     |
| Squash, winter           | Cut or break into pieces. Remove seeds and cavity pulp. Cut into 1" wide strips. Peel rind. Cut strips crosswise into pieces about 1/8" thick. | 3                        | 4     | 10–16           | Tough to brittle    |
| Squash, summer or banana | Wash trim, cut into 1/4" slices.   | 3                        | 4     | 10–16           | Leathery to brittle |
| Tomatoes                 | Steam or dip in boiling water to loosen skins. Chill in cold water. Peel. Slice 1/2" thick or cut in 3/4" sections.                            | None                     | None  | 6–24            | Crisp               |

**FRUITS.** (See text for general preparation directions.)

| Fruit                          | Preparation   | Pretreatment   | Drying Procedure   |
|--------------------------------|---|--|--|
| Apples<br>(mature, firm)       | Wash. Pare, if desired, and core. Cut in rings or slices 1/8"–1/4" thick or cut in quarters or eighths. Coat with ascorbic acid solution to prevent darkening during preparation (uses 2 1/4 tsp/ cup water). | Choose one:<br>•Soak 5 min. in sodium sulfite solution. Depending on size and texture.<br>•Steam-blanch 3–5 min., Depending on size and texture. | Arrange in single layer on trays, pit side up. Dry until soft, pliable and leathery; no moist area in center when cut.   |
| Apricots<br>(firm, fully ripe) | Wash. Cut in half and remove pit (do not peel). Coat with ascorbic acid solution to prevent darkening during preparation (1 tsp/cup).   | Choose one:<br>•Soak 5 min. in sodium sulfite solution.<br>•Steam blanch 3–5 min.  | 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<br>(firm, ripe)        | Peel. Cut in 1/8" slices.   | No treatment necessary; may choose:<br>•Dip in lemon juice.  | Arrange in single layer on trays. Dry until tough and leathery.  |
| Berries<br>(firm)              | Wash. Leave whole or cut in half.   | No treatment necessary; may choose:<br>•Dip in boiling water 15–30 sec. to crack skins.<br>•Steam blanch 30 sec. to 1 min.                       | Spread in layer not more than two berries deep. Dry until hard and berries rattle when shaken on trays.  |

| <b>Fruit</b>  | <b>Preparation</b>  | <b>Pretreatment</b>  | <b>Drying Procedure</b>  |
|---|---|--|--|
| Cherries<br>(fully ripe)  | Wash. Remove stems and pits.  | No treatment necessary; may choose:<br>•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"–1/8" of the peel; avoid white bitter part.  | No pretreatment necessary.   | Arrange in single layers trays. Dry at 130° 1–2 hours; then 120° 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 in halves or slices.  | No treatment necessary; may choose:<br>•Crack skins of whole figs in boiling water 15–30 sec.                            | Arrange in single layer on trays. Dry until leathery and pliable.  |
| Grapes and black currants (seedless varieties)                                    | Wash, sort, leave whole on stems in small bunches, if desired. May also remove stems.   | No treatment necessary; may choose:<br>•Crack skins in boiling water 15–30 sec.<br>•Steam blanch 1 min.                  | 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"–1/2" 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 in quarters or slices if desired. Coat with ascorbic acid solution to prevent darkening during preparation (1tsp/cup)   | Choose one:<br>•Soak 5–15 min. in sodium sulfite<br>•Steam blanch halves 8–10 min, slices. 2–3 min                       | 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 wash and core. Cut in quarters or eighths or slice 1/8"–1/4" thick. Coat with ascorbic acid solution to prevent darkening during preparation (1tsp/cup). | Choose one:<br>•Soak 5–15 min. in sodium sulfite<br>•Steam blanch 5–7 min.   | Arrange in single layer on trays pit side up. Dry until springy and suedelike with no pockets of moisture.   |
| Plums and prunes  | Wash. Leave whole if small; cut large fruit into halves (pit removed) or slices.  | No treatment necessary; may choose:<br>•Steam blanch halves or slices 5–7 min.<br>•Crack skins in boiling water 1–2 min. | 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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