UNIVERSITY OF GEORGIA COOPERATIVE EXTENSION SERVICE
COLLEGE OF FAMILY AND CONSUMER SCIENCES
in cooperation with the COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

Preserving Food: Drying Fruits *and* Vegetables

Food drying is one of the oldest methods of preserving food for later use. It can either be an alternative to canning or freezing, or compliment these methods. Drying foods is simple, safe and easy to learn. With modern food dehydrators, fruit leathers, banana chips and beef jerky can all be dried year round at home.

How Drying Preserves Food

Drying removes the moisture from the food so bacteria, yeast and mold cannot grow and spoil the food. Drying also slows down the action of enzymes (naturally occurring substances which cause foods to ripen), but does not inactivate them.

Because drying removes moisture, the food becomes smaller and lighter in weight. When the food is ready for use, the water is added back, and the food returns to its original shape.

Foods can be dried in the sun, in an oven or in a food dehydrator by using the right combination of warm temperatures, low humidity and air current.

In drying, warm temperatures cause the moisture to evaporate. Low humidity allows moisture to move quickly from the food to the air. Air current speeds up drying by moving the surrounding moist air away from the food.

Drying Foods Out-of-Doors

Sun Drying

The high sugar and acid content of fruits make them safe to dry in the sun. Vegetables and meats are not recommended for sun drying. Vegetables are low in sugar and acid. This increases the risks for food spoilage. Meats are high in protein making them ideal for microbial growth when heat and humidity cannot be controlled.

To dry in the sun, hot, dry, breezy days are best. A minimum temperature of 86°F is needed with higher temperatures being better. It takes several days to dry foods out-of-doors. Because the weather is uncontrollable, sun drying can be risky.

Also, the high humidity in the South is a problem. A humidity below 60 percent is best for sun drying. Often these ideal conditions are not available when fruit ripens.

Fruits dried in the sun are placed on trays made of screen or wooden dowels. Screens need to be safe for contact with food. The best screens are stainless steel, teflon coated fiberglass or plastic. Avoid screens made from "hardware cloth." This is galvanized metal cloth that is coated with cadmium or zinc. These materials can oxidize, leaving harmful residues on the food. Also avoid copper and aluminum screening. Copper destroys vitamin C and increases oxidation. Aluminum tends to discolor and corrode.

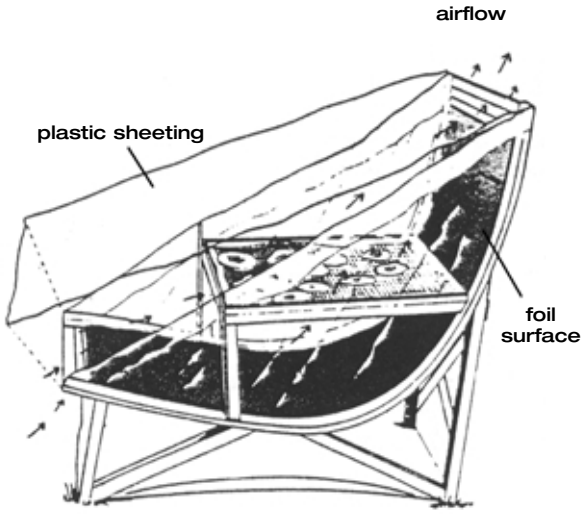
Outdoor Drying Rack

Most woods are fine for making trays. However, do not use green wood, pine, cedar, oak or redwood. These woods warp, stain the food or cause off-flavors in the food.

Place trays on blocks to allow for better air movement around the food. Because the ground may be moist, it is best to place the racks or screens on a concrete driveway or if possible over a sheet of aluminum or tin. The reflection of the sun on the metal increases the drying temperature. Cover the trays with cheesecloth to help protect the fruit from birds or insects. Fruits dried in the sun must be covered or brought under shelter at night. The cool night air condenses and could add moisture back to the food, thus slowing down the drying process.

Solar Drying

Recent efforts to improve on sun drying have led to solar drying. Solar drying also uses the sun as the heat source. A foil surface inside the dehydrator helps to increase the temperature. Ventilation speeds up the drying time. Shorter drying times reduce the risks of food spoilage or mold growth.



Homemade Solar Dryer

Pasteurization

Sun or solar dried fruits and vine dried beans need treatment to kill any insect and their eggs that might be on the food. Unless destroyed, the insects will eat the dried food. There are two recommended pasteurization methods:

1. **Freezer Method -** Seal the food in freezer-type plastic bags. Place the bags in a freezer set at 0°F or below and leave them at least 48 hours.

2. **Oven Method -** Place the food in a single layer on a tray or in a shallow pan. Place in an oven preheated to 160°F for 30 minutes.

After either of these treatments the dried fruit is ready to be conditioned and stored.

Drying Foods Indoors

Most foods can be dried indoors using modern dehydrators, convection ovens or conventional ovens. Microwave ovens are recommended only for drying herbs, because there is no way to create airflow in them.

Food Dehydrators

A food dehydrator is a small electrical appliance for drying food indoors. A food dehydrator has an electric element for heat and a fan and vents for air circulation. Dehydrators are efficiently designed to dry foods quickly at 140°F.

Food dehydrators are a relatively new item and are available from department stores, mail-order catalogs, natural food stores, seed catalogs and garden supply stores. Costs vary from $40 to $350 or above depending on features. Some models are expandable and additional trays can be purchased later. Twelve square feet of drying space dries about a half-bushel of produce.

Oven Drying

Everyone who has an oven has a dehydrator. By combining the factors of heat, low humidity and air flow, an oven can be used as a dehydrator.

An oven is ideal for occasional drying of meat jerkies, fruit leathers, banana chips or for preserving excess produce like celery or mushrooms. Because the oven is needed for every day cooking, it may not be satisfactory for preserving abundant garden produce.

Oven drying is slower than dehydrators because it does not have a built-in fan for the air movement. (However, some convection ovens do have a fan). It takes about two times longer to dry food in an oven than it does in a dehydrator. Thus, the oven is not as efficient as a dehydrator and uses more energy.

To Use Your Oven - First, check the dial and see if it can register as low as 140°F. If your oven does not go this low, then your food will cook instead of dry. Use a thermometer to check the temperature at the "warm" setting.

For air circulation, leave the oven door propped open two to six inches. Circulation can be improved by placing a fan outside the oven near the door. CAUTION: This is not a safe practice for a home with small children.

Because the door is left open, the temperature will vary. An oven thermometer placed near the food gives an accurate reading. Adjust the temperature dial to achieve the needed 140°F.

Drying trays should be narrow enough to clear the sides of the oven and should be 3 to 4 inches shorter than the oven from front to back. Cake cooling racks placed on top of cookie sheets work well for some foods. The oven racks, holding the trays, should be two to three inches apart for air circulation.

DRYING FRUITS

Dried fruits are unique, tasty and nutritious. Begin by washing the fruit and coring it, if needed. For drying, fruits can be cut in half or sliced. Some can be left whole. See the table “Drying Fruits at Home” later in this publication for specific directions for preparing each fruit.

Thin, uniform, peeled slices dry the fastest. The peel can be left on the fruit, but unpeeled fruit takes the longer to dry. Apples can be cored and sliced in rings, wedges, or chips. Bananas can be sliced in coins, chips or sticks.

Fruits dried whole take the longest to dry. Before drying, skins need to be "checked" or cracked to speed drying. To "check" the fruit place it in boiling water and then in cold water.

Because fruits contain sugar and are sticky, spray the drying trays with nonstick cooking spray before placing the fruit on the trays. After the fruit dries for one to two hours, lift each piece gently with a spatula and turn.

Pretreating the Fruit

Pretreatments prevent fruits from darkening. Many light-colored fruits, such as apples, darken rapidly when cut and exposed to air. If not pretreated, these fruits will continue to darken after they have dried.

For long-term storage of dried fruit, sulfuring or using a sulfite dip are the best pretreatments. However, sulfites found in the food after either of these treatments have been found to cause asthmatic reactions in a small portion of the asthmatic population. Thus, some people may want to use the alternative shorter-term pretreatments. If home dried foods are eaten within a short time, there may be little difference in the long- and short-term pretreatments.

Sulfuring - Sulfuring is an old method of pretreating fruits. Sublimed sulfur is ignited and burned in an enclosed box with the fruit. The sulfur fumes penetrate the fruit and act as a pretreatment by retarding spoilage and darkening of the fruit. Fruits must be sulfured out-of-doors where there is adequate air circulation. (For more information contact your county Extension office.)

Sulfite Dip - Sulfite dips can achieve the same long-term anti-darkening effect as sulfuring, but more quickly and easily. Either sodium bisulfite, sodium sulfite or sodium meta-bisulfite that are USP (food grade) or Reagant grade (pure) can be used. To locate these, check with your local drugstores or hobby shops, where wine-making supplies are sold.

Directions for Use - Dissolve 3⁄4 to 1 1⁄2 teaspoons sodium bisulfite per quart of water. (If using sodium sulfite, use 1 1⁄2 to 3 teaspoons. If using sodium metabisulfite, use 1 to 2 tablespoons.) Place the prepared fruit in the mixture and soak 5 minutes for slices, 15 minutes for halves. Remove fruit, rinse lightly under cold water and place on drying trays. Sulfited foods can be dried indoors or outdoors. (This solution can be used only once. Make a new one for the next batch.)

Ascorbic Acid - Ascorbic acid (vitamin C) mixed with water is a safe way to prevent fruit browning. However, its protection does not last as long as sulfuring or sulfiting. Ascorbic acid is available in the powdered or tablet form, from drugstores or grocery stores. One teaspoon of powdered ascorbic acid is equal to 3000 mg

of ascorbic acid in tablet form. (If you buy 500 mg tablets, this would be six tablets).

Directions for Use - Mix 1 teaspoon of powdered ascorbic acid (or 3000 mg of ascorbic acid tablets, crushed) in 2 cups water. Place the fruit in the solution for 3 to 5 minutes. Remove fruit, drain well and place on dryer trays. After this solution is used twice, add more acid.

Ascorbic Acid Mixtures - Ascorbic acid mixtures are a mixture of ascorbic acid and sugar sold for use on fresh fruits and in canning or freezing. It is more expensive and not as effective as using pure ascorbic acid.

Directions for Use - Mix 1 1⁄2 tablespoons of ascorbic acid mixture with one quart of water. Place the fruit in the mixture and soak 3 to 5 minutes. Drain the fruit well and place on dryer trays. After this solution is used twice, add more ascorbic acid mixture.

Fruit Juice Dip - A fruit juice that is high in vitamin C can also be used as a pretreatment, though it is not as effective as pure ascorbic acid. Juices high in vitamin C include orange, lemon, pineapple, grape and cranberry. Each juice adds its own color and flavor to the fruit.

Directions for Use - Place enough juice to cover fruit in a bowl. Add cut fruit. Soak 3 to 5 minutes, remove fruit, drain well and place on dryer trays. This solution may be used twice, before being replaced. (The used juice can be consumed.)

Honey Dip - Many store-bought dried fruits have been dipped in a honey solution. A similar dip can be made at home. Honey dipped fruit is much higher in calories.

Directions for Use - Mix 1⁄2 cup sugar with 1 1⁄2 cups boiling water. Cool to lukewarm and add 1/2 cup honey. Place fruit in dip and soak 3 to 5 minutes. Remove, drain well and place on dryer trays.

Syrup Blanching - Blanching fruit in syrup helps it retain color fairly well during drying and storage. The resulting product is similar to candied fruit. Fruits that can be syrup blanched include apples, apricots, figs, nectarines, peaches, pears, plums and prunes.

Directions for Use - Combine 1 cup sugar, 1 cup light corn syrup and 2 cups water in a saucepot. Bring to a boil. Add 1 pound of prepared fruit and simmer 10 minutes. Remove heat and let fruit stand in hot syrup for 30 minutes. Lift fruit out of syrup, rinse lightly in cold water, drain on paper toweling and place on dryer trays.

Steam Blanching - Steam blanching also helps retain color and slow oxidation. However, the flavor and texture of the fruit is changed.

Directions - Place several inches of water in a large saucepot with a tight fitting lid. Heat to boiling. Place fruit not more than 2 inches deep, in a steamer pan or wire basket over boiling water. Cover tightly with lid and begin timing immediately. See below for blanching times. Check for even blanching half way through the blanching time. Some fruit may need to be stirred. When done, remove excess moisture using paper towels and place on dryer trays.

Drying the Prepared Fruit

Whichever drying method you choose-sun drying, solar drying, oven drying or dehydrator drying-be sure to place the fruit in a single layer on the drying trays. The pieces should not touch or overlap. Follow the directions for the drying method you choose and dry until the food tests dry. Approximate drying times are given below. Food dries much faster at the end of the drying period, so watch it closely.

Determining Dryness of Fruits

Since dried fruits are generally eaten without being rehydrated, they should not be dehydrated to the point of brittleness. Most fruits should have about 20 percent moisture content when dried.

To test for dryness, cut several cooled pieces in half. There should be no visible moisture and you should not be able to squeeze any moisture from the fruit. Some fruits may remain pliable, but are not sticky or tacky. If a piece is folded in half, it should not stick to itself. Berries should be dried until they rattle when shaken.

After drying, cool fruit 30 to 60 minutes before packaging. Packaging food warm can lead to sweating and moisture buildup. However, excessive delays in packaging could allow moisture to re-enter food. Remember, if you have dried fruit in the sun, it must be pasteurized before it is packaged.

Conditioning Fruits

When dried fruit is taken from the dehydrator or oven, the remaining moisture may not be distributed equally among the pieces because of their size or their location in the dehydrator. Conditioning is a process used to equalize the moisture and reduce the risk of mold growth.

To condition the fruit, take the dried fruit that has cooled and pack it loosely in plastic or glass jars. Seal the containers and let them stand for seven to ten days. The excess moisture in some pieces will be absorbed by the drier pieces. Shake the jars daily to separate the pieces and check the moisture condensation. If condensation develops in the jar, return the fruit to the dehydrator for more drying. After conditioning, package and store the fruit.

DRYING VEGETABLES

Vegetables can also be preserved by drying. Because they contain less acid than fruits, vegetables are dried until they are brittle. At this stage, only 10% moisture remains and no microorganism can grow.

Preparing Vegetables

To prepare vegetables for drying, wash in cool water to remove soil and chemical residues. Trim, peel, cut, slice or shred vegetables according to the directions for each vegetable in the chart below. Remove any fibrous or woody portions and core when necessary, removing all decayed and bruised areas. Keep pieces uniform in size so they will dry at the same rate. A food slicer or food processor can be used. Prepare only as many as can be dried at one time.

Pretreating Vegetables

Blanching is a necessary step in preparing vegetables for drying. By definition, blanching is the process of heating vegetables to a temperature high enough to destroy enzymes present in tissue. Blanching stops the enzyme action which could cause loss of color and flavor during drying and storage. It also shortens the drying and rehydration time by relaxing the tissue walls so moisture can escape and later re-enter more rapidly.

Vegetables can be water blanched or steam blanched. Water blanching usually results in a greater loss of nutrients, but it takes less time than steam blanching.

Water Blanching - Fill a large pot 2/3 full of water, cover and bring to a rolling boil. Place the vegetables in a wire basket or a colander and submerge them in the water. Cover and blanch according to directions. Begin timing when water returns to boiling. If it takes longer than one minute for the water to come back to boiling, too many vegetables were added. Reduce the amount in the next batch.

Steam Blanching - Use a deep pot with a tight fitting lid and a wire basket, colander or sieve placed so the steam will circulate freely around the vegetables. Add water to the pot and bring to a rolling boil. Place the vegetables loosely in the basket no more than 2 inches deep. Place the basket of vegetables in the pot, making sure the water does not come in contact with the vegetables. Cover and steam according to the directions.

Cooling and Drying the Prepared Vegetables

After blanching, dip the vegetables briefly in cold water. When they feel only slightly hot to the touch, drain the vegetables by pouring them directly onto the drying tray held over the sink. Wipe the excess water from underneath the tray and arrange the vegetables in a single layer. Then place the tray immediately in the dehydrator or oven. The heat left in the vegetables from blanching will cause the drying process to begin more quickly. Watch the vegetables closely at the end of the drying period. They dry much more quickly at the end and could scorch.

Determining Dryness of Vegetables

Vegetables should be dried until they are brittle or "crisp." Some vegetables would actually shatter if hit

with a hammer. At this stage, they should contain about 10 percent moisture. Because they are so dry, they do not need conditioning like fruits.

DRYING FRUIT LEATHER

Fruit leather is a tasty, chewy, dried fruit product. Fruit leathers are made by pouring puréed fruit onto a flat surface for drying. When dried, the fruit is pulled from the surface and rolled. It gets the name "leather" from the fact that when puréed fruit is dried, it is shiny and has the texture of leather.

Leather From Fresh Fruit

* Select ripe or slightly overripe fruit.
* Wash fresh fruit or berries in cool water. Remove peel, seeds and stem.
* Cut fruit into chunks. Use 2 cups of fruit for each 13" x 15" inch fruit leather. Purée fruit until smooth.
* Add 2 teaspoons of lemon juice or 1/8 teaspoon

ascorbic acid (375 mg) for each 2 cups of light colored fruit to prevent darkening.

* Optional: To sweeten, add corn syrup, honey or sugar. Corn syrup or honey is best for longer storage because it prevents crystals. Sugar is fine for immediate use or short storage. Use 1/4 to 1/2 cup sugar, corn syrup or honey for each 2 cups of fruit. Saccharin-based sweeteners could also be used to reduce tartness without adding calories. Aspartame sweeteners may lose sweetness during drying.

Leathers From Canned or Frozen Fruits

* Home preserved or store bought canned or frozen fruit can be used.
* Drain fruit, save liquid.
* Use 1 pint of fruit for each 13" x 15" leather.
* Purée fruit until smooth. If thick, add liquid.
* Add 2 teaspoons of lemon juice or 1/8 teaspoon ascorbic acid (375 mg) for each 2 cups of light colored fruit to prevent darkening.
* If desired, sweeten as directed above for leathers from fresh fruit.
* Applesauce can be dried alone or added to any fresh fruit purée as an extender. It decreases tartness and makes leather smoother and more pliable.

Drying the Leather

For drying in the oven or sun, line cookie sheets with plastic wrap. In a dehydrator, use plastic wrap or the specially designed plastic sheets that come with the dehydrator. Pour the leather onto the lined cookie sheets or tray. Spread it evenly to a thickness of 1/8 inch.

Dry the fruit leather at 140° F until no indention is left when you touch the center with your finger. This could take about 6 to 8 hours in the dehydrator, up to 18 hours in the oven and 1 to 2 days in the sun. While still warm, peel from the plastic wrap. Cool and rewrap in plastic and store.

PACKAGING AND STORING DRIED FOODS

After foods are dried, cool them completely. Then package them in clean moisture-vapor-resistant containers. Glass jars, metal cans or freezer containers are good storage containers, if they have tight-fitting lids. Plastic freezer bags are acceptable, but they are not insect and rodent proof. Fruit that has been sulfured or sulfited should not touch metal. Place the fruit in a plastic bag before storing it in a metal can.

Dried food should be stored in a cool, dry, dark place. Most dried fruits can be stored for 1 year at 60° F, 6 months at 80° F. Dried vegetables have about half the shelf-life of fruits. Fruit leathers should keep for up to 1 month at room temperature. To store any dried product longer, place it in the freezer.

USING DRIED FOODS

Dried fruits can be eaten as is or reconstituted. Dried vegetables must be reconstituted. Once reconstituted, dried fruits or vegetables are treated as fresh. Fruit leathers and meat jerky are eaten as is.

To reconstitute dried fruits or vegetables, add water to the fruit or vegetable and soak until the desired volume is restored. (See the chart on rehydrating dried food, for the amount of water to add and minimum soaking time.) Do not over-soak the food. Over-soaking produces loss of flavor and a mushy, water-logged texture.

For soups and stews, add the dehydrated vegetables, without rehydrating them. They will rehydrate as the soup or stew cooks. Also, leafy vegetables and tomatoes do not need soaking. Add enough water to cover and simmer until tender. CAUTION! If soaking takes more than 2 hours, refrigerate the product for the remainder of the time.

Rehydrating Dried Foods

Product	Water to Add to 1 Cup Dried Food (Cups)	Minimum Soaking Time (Hours)
Fruits*		
Apples	1 1/2	1/2
Pears	1 3/4	1 1/4
Peaches	2	1 1/4
Vegetables**		
Asparagus	2 1/4	1 1/2
Beans, lima	2 1/2	1 1/2
Beans, green snap	2 1/2	1
Beets	2 3/4	1 1/2
Carrots	2 1/4	1
Cabbage	3	1
Corn	2 1/4	1/2
Okra	3	1/2
Onions	2	3/4
Peas	2 1/2	1/2
Pumpkin	3	1
Squash	1 3/4	1
Spinach	1	1/2
Sweet Potatoes	1 1/2	1/2
Turnip Greens and other greens	1	3/4

* Fruits – Water is at room temperature.
** Vegetables – Boiling water used.

Drying Fruits at Home

Fruit	Preparation	Pretreatment (Choose One)			Other	Drying Times Dehydrator* (hours)
			Blanch			
		Sulfur (hours)	Steam (minutes)	Syrup (minutes)		
Apples	Peel and core, cut into slices or rings about 1/8 inch thick.	3/4	3-5 min, depending on texture	10	-ascorbic acid mixture -ascorbic acid solution -fruit juice dip -sulfite dip	6-12
Apricots	Pit and halve. May slice if desired.	2	3-4	10	-ascorbic acid mixture -ascorbic acid solution -fruit juice dip -sulfite dip	24-36**
Bananas	Use solid yellow or slightly brown-flecked bananas. Avoid bruised or overripe bananas. Peel and slice 1/4-inch to 3/8-inch thick, crosswise or lengthwise.				-honey dip -ascorbic acid solution -ascorbic acid mixture -fruit juice dip -sulfite dip	8-10
Berries						
Firm	Wash and drain berries with waxy coating (blueberries, cranberries, currants, gooseberries, huckleberries).				-plunge into boiling water 15-30 seconds to "check" skins. Stop cooking action by placing fruit in ice water. Drain on paper towels.	24-36
Soft	Wash and drain. (boysenberries, strawberries)				-No pretreatment necessary.	
Cherries	Stem, wash, drain and pit fully ripe cherries. Cut in half, chop, or leave whole.			10 (for sour cherries)	-Whole: dip in boiling water 30 seconds or more to check skins. -Cut and pitted: No -Pretreatment necessary.	24-36
Citrus Peel	Peels of citron, grapefruit, kumquat, lime, lemon, tangelo and tangerine can be dried. Thick-skinned navel orange peel dries better than thin-skinned Valencia peel. Wash thoroughly. Remove outer 1/6 to 1/8 inch of peel. Avoid white bitter pith.				-No pretreatment necessary.	8-12
Figs	Select fully ripe fruit. Immature fruit may sour before drying. Wash or clean whole fruit with damp cloth. Leave small fruit whole, otherwise cut in half.	1 (whole)			-Whole: Dip in boiling water 30 seconds or more to check skins. Plunge in ice water to stop further cooking. Drain on paper towels.	6-12**
Grapes						
Seedless	Leave whole.				-Whole: Dip in boiling water 30 seconds or more to check skins. Plunge in ice water to stop further cooking. Drain on paper towels. -Halves: no pretreatment necessary.	12-20
With seeds	Cut in half and remove seeds.					

Drying Fruits at Home (continued)

Fruit	Preparation	Pretreatment (Choose One)				Drying Times
			Blanch			
		Sulfur (hours)	Steam (minutes)	Syrup (minutes)	Other	Dehydrator* (hours)
Nectarines and Peaches	When sulfering, pit and halve; if desired, remove skins. For steam and syrup blanching, leave whole, then pit and halve. May also be sliced or quartered.	2-3 (halves) 1 (slice)	8	10	-ascorbic acid solution -ascorbic acid mixture -fruit juice dip -sulfiting	36-48**
Pears	Cut in half and core. Peeling preferred. May also slice or quarter.	5 (halves) 2 (slices)	6 minutes (halves)	10	-ascorbic acid solution -ascorbic acid mixture -fruit juice dip -sulfiting	24-36**
Persimmons	Use firm fruit of long, soft varieties and fully ripe fruit of round drier varieties. Peel and slice using stainless steel knife.				-may syrup blanch	12-15**
Pineapple	Use fully ripe, fresh pineapple. Wash, peal and remove thorny eyes. Slice lengthwise and remove core. Cut in 1/2-inch slices, crosswise.				No pretreatment necessary	24-36
Plums (Prunes)	Leave whole or if sulfuring, halve the fruit.	1			-Sun drying: (whole) dip in boiling water 30 seconds or more to check skins. -Oven or dehydrator drying: rinse in hot tap water.	24-36**

* Because of variations in air circulation, drying times in conventional ovens could be up to twice as long. Drying times for sun drying could range from 2 to 6 days, depending on temperature and humidity.

** Drying times are shorter for slices and other cuts of fruit.

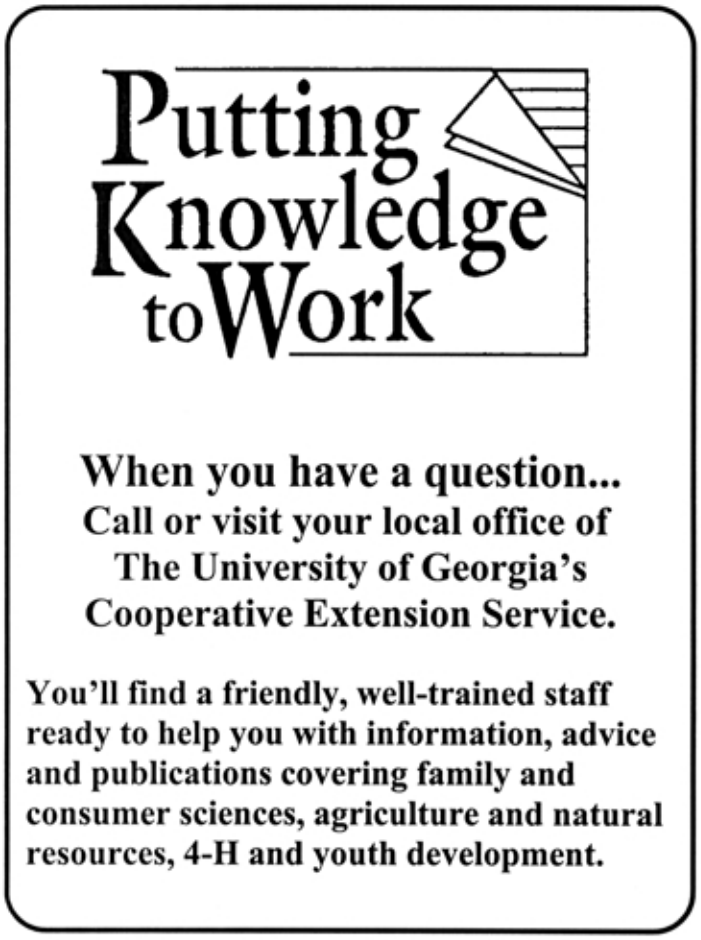
Drying Vegetables at Home

Vegetable	Preparation	Blanching Time Steam (minutes)	Blanching Time Water (minutes)	Drying Time Dehydrator* (hours)
Artichokes-Globe	Cut hearts into 1/8-inch strips. Heat in boiling solution of 3/4 cups water and 1 tablespoon lemon juice.		6-8	4-6
Asparagus	Wash thoroughly. Cut large tips in half.	4-5	3 1/2 - 4 1/2	4-6
Beans, green	Wash thoroughly. Cut in short pieces or lengthwise. (May freeze for 30 to 40 minutes after blanching for better texture.)	2-2 1/2	2	8-14
Beets	Cook as usual. Cool; peel. Cut into shoestring strips 1/8-inch thick.	Already cooked no further blanching required.		10-12
Broccoli	Trim, cut as for serving. Wash thoroughly. Quarter stalks lengthwise.	3-3 1/2	2	12-15
Brussels Sprouts	Cut in half lengthwise through stem.	6-7	4 1/2 - 5 1/2	12-18
Cabbage	Remove outer leaves; quarter and core. Cut into strips 1/8-inch thick.	2 1/2-3**	1 1/2-2	10-12
Carrots	Use only crisp, tender carrots. Wash thoroughly. Cut off roots and tops; preferably peel, cut in slices or strips 1/8-inch thick.	3-3 1/2	3 1/2	10-12
Cauliflower	Prepare as for serving.	4-5	3-4	12-15
Celery	Trim stalks. Wash stalks and leaves thoroughly. Slice stalks.	2	2	10-16
Corn, cut	Husk, trim and blanch until milk does not exude from kernel when cut. Cut the kernels from the cob after blanching.	2-2 1/2	1 1/2	6-10
Eggplant	Use the same directions as for summer squash	3 1/2	3	12-14
Garlic	Peel and finely chop garlic bulbs. No other pretreatment is needed. Odor is pungent.	No blanching is needed.		6-8
Greens (chard, kale, turnip, spinach)	Use only young tender leaves. Wash and trim very thoroughly.	2-2 1/2**	1 1/2	8-10
Horseradish	Wash; remove small rootlets and stubs. Peel or scrape roots. Grate.		none	4-10
Mushrooms (WARNING, see footnote***)	Scrub thoroughly. Discard any tough, woody stalks. Cut tender stalks into short sections. Do not peel small mushrooms or "buttons." Peel large mushrooms, slice.		none	8-10

Drying Vegetables at Home (continued)

Vegetable	Preparation	Blanching Time Steam (minutes)	Blanching Time Water (minutes)	Drying Time Dehydrator* (hours)
Okra	Wash, trim, slice crosswise in 1/8- to 1/4-inch disks.		none	8-10
Onions	Wash, remove outer "paper shells." Remove tops and root ends, slice 1/8- to 1/4-inch thick.		none	3-9
Parsley	Wash thoroughly. Separate clusters. Discard long or tough stems.		none	1-2
Peas, Green	Shell	3	2	8-10
Peppers, and Pimientos	Wash, stem, core. Remove "partitions." Cut into disks about 3/8 by 3/8 inch.		none	8-12
Potatoes	Wash, peel. Cut into shoestring strips 1/4-inch thick, or cut in slices 1/8-inch thick.	6-8	5-6	8-12
Pumpkin and Hubbard Squash	Cut or break into pieces. Remove seeds and cavity pulp. Cut into 1-inch wide strips. Peel rind. Cut strips crosswise into pieces about 1/8-inch thick.	2 1/2-3	1	10-16
Squash: Summer	Wash, trim, cut into 1/4-inch slices.	2 1/2-3	1 1/2	10-12
Tomatoes, for stewing	Steam or dip in boiling water to loosen skins. Chill in cold water. Peel. Cut into sections about 3/4-inch wide, or slice. Cut small pear or plum tomatoes in half.	3	1	10-18

* Drying times in a conventional oven could be up to twice as long, depending on air circulation.
** Steam until wilted.
*** WARNING: The toxins in poisonous varieties of mushrooms are not destroyed by drying or by cooking. Only an expert can differentiate between poisonous and edible varieties.



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Gale A. Buchanan, Dean and Director

FDNS-E-43-10 07-00

Colorado State University Extension

Leathers and Jerkies

Fact Sheet No. **9.311** Food and Nutrition Series | **Preparation**

by P. Kendall and J. Sofos*

Fruit Leather

Fruit leather is made by drying thin layers of pureed fruit in the oven or dehydrator. Sometimes called fruit rolls or taffies, fruit leathers make delicious, wholesome and nutritious high-energy snacks for people on the go. They are relatively light in weight, easy to prepare and a good way to use left-over canned fruit and slightly over-ripe fresh fruit.

Fruit leathers can be eaten as is, or made into a beverage by combining 5 parts water with 1 part leather in a food blender. They also can be used in pie fillings, in cooking and as a dessert topping.

Most fruit or combinations of fruits can be used. Apricots, apples, grapes, berries, bananas, pineapples, oranges, pears, peaches, plums, melons, and most tropical fruits can be blended and dried to make fruit leathers. Grapefruit and lemons are not recommended because they turn bitter when dried.

Drying is one of the least exact ways to preserve foods. The length of drying time will depend on the equipment used and the humidity of the air. In the past, recommendations for preparing fruit leather from both fresh and cooked fruit have been given. However, because of increasing concerns with bacteria such as *Escherichia coli* O157:H7 (*E. coli* O157:H7) being able to survive the drying process if present, it's best to heat the fruit to 160°F before drying. Pre-heating also stops the maturing action of enzymes in the fruit, helps preserve the fruit's natural color and speeds the drying process.

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Leather Preparation

Select ripe or slightly over-ripe fruit. Sort and thoroughly rinse or scrub the fruit under running water. Remove and discard blemishes or defective parts. Peel tough-skinned fruits such as winter apples, oranges, peaches, pears and tomatoes, if desired. Pit and core fruit as needed. Remove seeds from grapes. Hull strawberries.

Cut fruit into chunks and place in the top of a double boiler. Place water in the bottom of the double boiler and bring to a boil. Cover and steam for 15 to 20 minutes or until the fruit is soft and a thermometer placed in the fruit mixture registers at 160°F. The fruit mixture may also be cooked in a microwave oven. Place cut fruit in a glass casserole. Cover and microwave on full power (high) for 6 to 8 minutes per two cups of fruit, stirring every 2 minutes.

Place cooked fruit in blender. Add ½ teaspoon of ascorbic acid crystals or 2 tablespoons lemon juice per 2 cups of fruit to protect the color and help destroy bacteria during drying. If desired, add 1 to 2 tablespoons of sugar, corn syrup or honey per 2 cups of fruit. A small amount of spice (¼ teaspoon cinnamon or a dash of nutmeg) may also be added per 2 cups puree, for taste variety.

Shortcut canned method. Substitute canned fruit or strained baby food without tapioca for the cooked fruit above. Canned applesauce and strained baby fruit will not need to be pureed. Other canned fruits will need to be drained and pureed in a blender, food grinder or by hand. Canned fruits are already processed, which destroys bacteria and stops enzyme action. Thus, the addition of ascorbic acid or lemon juice is not necessary.

Quick Facts

- Fruit leather is made by drying thin layers of pureed fruit in the oven or dehydrator.
- Fruit leather dries in 4 to 10 hours at 140°F to 145°F.
- Properly dried fruit leather is translucent and slightly tacky to the touch, but easily peeled from the pan.
- Jerky is made by drying thin strips of lean meat in the oven or dehydrator at 145°F for 10 to 14 hours.
- Only tested recipes that assure adequate destruction of bacteria should be used for fruit leather and jerky preparation.
- Always wash and sanitize cutting boards, utensils, and counters with hot, soapy water before and after any contact with raw meat or juices.

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Figure 1. Spread fruit concentrate.

Canned fruits, such as applesauce, can be mixed with more expensive freshly cooked fruits to stretch the concentrate and soften the flavor. The addition of applesauce to juicy fruits also eases drying.

Leather Drying

Spray a cookie sheet or similar flat tray with vegetable spray or line with plastic wrap. Make sure the cookie sheet or tray has an edge to prevent spillage of the puree. Spread the fruit concentrate evenly over the pan surface to a depth of 1/8 to 1/4-inch (see Figure 1). Two cups of puree is enough to cover a 12- by 17-inch cookie sheet. Dry the concentrate in an oven or dehydrator.

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. Check the oven temperature periodically with a thermometer to be sure the air temperature of the oven is at the desired level. If necessary, turn off the oven for a short time to reduce the temperature. The fruit concentrate 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. Test frequently for dryness. Drying time will be 4 to 10 hours.

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. Test for dryness by touching the leather in several places; no indentations should be evident. 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.

Storage. After loosening the edge of the leather from the plastic wrap or pan, loosely roll the leather in plastic wrap or waxed paper in one piece. Store the roll in one piece or cut into 1-inch strips. Place the strips or rolls of leather in a plastic bag, glass container, paper bag or other container. Until the leather is completely dry, the container lid should not be tightened nor the bag opening twisted tightly. If the leather has not dried completely, it may become sticky or develop mold growth during airtight storage.

Store fruit leather in a cool, dry, dark place. It will retain good quality for up to one year in the freezer, several months in the refrigerator, or one to two months at room temperature (70°F).

Nutritional Food Values

Nutritional food values become concentrated in dried fruit, and so do calories. Since moisture is gone, the residue is concentrated. A 1- by 17-inch strip of applesauce provides approximately 40 calories, assuming 2 cups of canned sweetened applesauce were dried on a 12- by 17-inch pan.

Meat Jerky

Jerky is made by drying thin strips of lean meat to about one-fourth its original weight. In the past, preparation and heating recommendations for jerky have been quite general. Recommendations have included drying in the sun, oven or dehydrator. Sun drying is no longer recommended due to a lack of steady controlled heat source (145°F) and the potential for contamination from animals, insects, dust and bacteria. Although drying in the oven or dehydrator allows for a safer product, illnesses in recent years due to *Salmonella* and *Escherichia coli* O157:H7 in homemade jerky products have raised questions about the safety of all methods of drying jerky products at home.

E. coli O157:H7 is especially dangerous because of the severe consequences of infection, particularly for people who are young, elderly or immuno-compromised. The pathogen has a very low infectious dose, thus raising concerns for food products consumed raw or with inadequate cooking. In addition, *E. coli* O157:H7 can adapt to acidic conditions and has been found to survive many weeks on dry surfaces, even at refrigerated temperatures. Thus, there is a strong indication for the potential risk of *E. coli* O157:H7 surviving in dried foods.

One method for ensuring the adequate destruction of *E. coli* O157:H7 during jerky preparation is to pre-cook the meat to 160°F before drying. This method is currently recommended by the Meat and Poultry Hotline (1-800-535-4555) of the U.S. Department of Agriculture (USDA). Pre-cooking creates a product that is different than traditional jerky and therefore may not be well received by consumers. Also, the product may not dry evenly throughout because of case-hardening on the outside surface.

The jerky preparation methods given below were developed as part of a joint project between the Department of Food Science and Human Nutrition and the Department of Animal Sciences at Colorado State University, and were found effective in reducing *E. coli* O157:H7 numbers in inoculated samples.

Jerky Preparation

Use only lean meats in excellent condition. Round, flank and chuck steak, rump roast, brisket and cross rib are good choices. Highly marbled and fatty cuts do not work as well. When preparing jerky products, keep raw meats and their juices away from other foods. Remove any thick connective tissue and gristle from meat. Trim off visible fat with a sharp knife. Fat becomes rancid quickly and causes

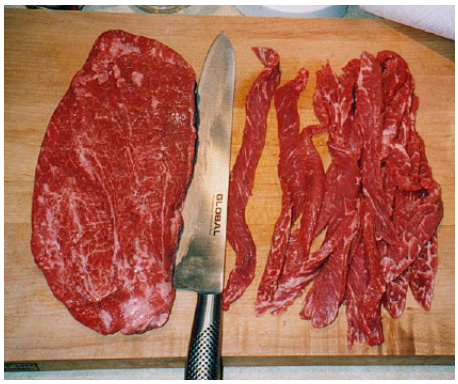

Figure 2. Cut jerky slices.

the development of off-flavors during drying or storage. Freeze meat in moisture-proof paper or plastic wrap until firm but not solid.

Slice the meat on a clean cutting board while still slightly frozen into long thin strips, approximately 1/8 to 1/4-inch thick, 1 to 1½-inches wide and 4 to 10 inches long (see Figure 2). If chewy jerky is preferred, slice with the grain; slice across the grain for a more tender, brittle jerky. Lay the strips out in a single layer on a clean and sanitized smooth surface (cutting board, counter top, cookie sheet). Flatten the strips with a rolling pin so they are fairly uniform in thickness. Prepare strips for drying using either the Hot Pickle Cure or Vinegar-Marinade preparation method described below:

Hot Pickle Cure Preparation Method

Ingredients per two pounds of lean meat strips:

Pickling Spices:

1 1/2 tablespoons salt
1 tablespoon sugar
1 teaspoon black pepper

Hot Pickle Brine:

3/4 cup salt
1/2 cup sugar
2 tablespoons black pepper
1 gallon water

Directions*:* Place jerky slices on clean cookie sheets or flat pans. Evenly distribute half of the pickling spices on the top surfaces of the jerky slices. Press spices into the meat slices with a rubber mallet or meat tenderizer. Turn slices and repeat on opposite sides. Cover and refrigerate for 24 hours.

Combine ingredients for hot pickle brine (salt, sugar, pepper, water) in a large kettle. Stir to dissolve salt and sugar and bring to a slow boil (175°F). Place a few meat slices at a time in a steamer basket and lower into brine. Simmer for 1½ to 2 minutes, stirring occasionally to make sure all pieces are immersed.

Lift basket out of kettle and drain off liquid. Using clean tongs, remove meat pieces and place flat, without touching each other, on clean dehydrator trays, oven racks or other drying trays. Immediately begin drying as described below. Repeat process until all meat pieces have been pickled in the brine solution and placed in the dehydrator or oven.

Vinegar-Marinade Preparation Method

Ingredients per two pounds of lean meat slices:

Pre-treatment dip:

2 cups vinegar

Marinade ingredients:

1/4 cup soy sauce
1 tablespoon Worcestershire sauce
1/4 teaspoon black pepper
1/4 teaspoon garlic powder
1/2 teaspoon onion powder
1 teaspoon hickory smoked salt

Directions*:* Place 2 cups vinegar in 9x11-inch cake pan or plastic storage container. Add meat strips to container, making sure vinegar covers all strips; let soak 10 minutes, stirring occasionally to ensure distribution of vinegar on strips.

Combine all marinade ingredients and place in a 1-gallon re-sealable plastic bag. Add lean meat slices to bag; seal bag and massage pieces to thoroughly distribute marinade over all meat strips. Refrigerate bag 1 to 24 hours.

Remove meat slices from bag, and place flat, without touching each other, on clean dehydrator trays, oven racks or other drying trays. Immediately begin drying.

Jerky Drying

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. Using clean tongs, arrange the meat strips in single layers on the drying trays without touching each other. 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 dryness. Properly dried jerky is chewy and leathery. It will be as brittle as a green stick, but won't snap like a dry stick. To test for dryness, remove a strip of jerky from the oven or dehydrator. Let cool slightly, then bend the jerky; it should crack, but not break when bent.

When jerky is sufficiently dry, remove the strips from the drying racks to a clean surface. Pat off any beads of oil with a paper towel and let cool.

Storage. Place cooled jerky strips in an airtight plastic food bag or jar with a tight fitting lid. Pack jerky with the least possible amount of air trapped in the container. Too much air causes off-flavors and rancidity to develop. Label and date packages.

Store containers of jerky in a cool, dry, dark place or the refrigerator or freezer.

Properly dried jerky will keep for approximately two weeks in a sealed container at room temperature. It will keep for 3 to 6 months in the refrigerator and up to one year in the freezer. Check occasionally to be sure no mold is forming.

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