

Home Drying of Food

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Drying of Food at Home

Preserving food by drying is the oldest method of food preservation. Sun drying of fruits and vegetables was practiced before biblical times by Chinese, Hindus, Persians, Greeks and Egyptians. Dried foods have the advantages of taking up very little space, not requiring refrigeration and providing variety to the diet. They are good for backpacking, lunches, camping, and snacks in general.

Drying is a comparatively simple process, requiring little outlay of equipment, time and money. Even though drying is not difficult, it does take time, constant attention, skill, and understanding of the principles of food drying methods.

How Does Drying Preserve Food?

Preserving food requires the control of enzymes and microorganisms. Microorganisms which grow rapidly on raw or fresh food products can be controlled by drying because the lack of water limits the growth of microorganisms; however, drying does not kill the microorganisms. Inactivation of enzymes in the fruit or vegetable is usually controlled by a pretreatment. Enzymes can catalyze undesirable flavor and color changes.

Nutritional Value of Dried Fruits and Vegetables

Fresh produce provides calories, fiber, minerals and vitamins. Changes that can be expected in home-dried food are listed below:

- **Calories:** No change. The calorie content of the dried food, however, will be higher per unit of weight because nutrients become more concentrated as water is removed.
- **Fiber:** No change
- **Minerals:** Some may be lost in soaking, but no data are available. None is lost in the drying process.
- **Vitamins:** Those most often found in fruit and vegetables are A, C and the B vitamins. If vegetables are blanched, vitamin A activity is maintained to a high degree. Losses of vitamin C vary widely depending on treatment. Speed in drying and absence of sunlight are advantages in maintaining ascorbic acid as is decreasing the air temperatures as complete dryness is approached. Only moderate losses of B vitamins occur during drying.

Yields

Because drying removes moisture, the food shrinks and decreases in size and weight, thus requiring less space for storage. When water is added to the dried product, it returns to its original size. Yields of dried products are directly related to how much water is in the original product. Twenty-five pounds of apples will yield about 4 pounds of dried apples. Twenty-five pounds of onions will yield about 3 pounds of dried onions.

Guides for Success in Drying

Selecting the Right Product

Fruits and vegetables selected for drying should be sound, fresh, and in the "peak" of condition; ripe, but still firm and at the right state of maturity. Wilted or inferior material will not make a satisfactory product. Immature fruits will be weak in color and flavor. Over-mature vegetables are usually tough and woody. Over-mature or bruised fruits are likely to spoil before the drying process can be accomplished. Fruit and vegetables that are inferior before drying will be inferior after drying.

Speed and Enzymatic Changes

Enzymatic changes take place rapidly in harvested food. Speed in both the preparation and in the drying process time is very important to a quality product. Process the produce while it is still fresh. Vegetables should be partially cooked by steaming or scalding. Fruits should be steamed, sulfured, or treated by soaking in salt, sulfite, or acid solutions.

Temperature

Heat is supplied by the sun or electrical heat. If the drying temperature is too low, the product will sour. Drying should be done as quickly as possible, at a temperature that does not seriously affect the texture, color, and flavor of the fruit or vegetable. If the temperature is too high or the humidity too low, there is a danger of moisture being removed too fast. This can cause a hardening of the outer cells of the product (case hardening) which prevents water vapor from diffusing from the inner cells.

Drying is best accomplished when the process is continuous. When heat is applied intermittently, temperatures conducive to bacterial growth can develop.

Circulation of Air

Each piece of food should have good exposure to air. Food should be only one layer deep with space around it. This space does not need to be large since the product will shrink during the drying process.

A good flow of air is necessary. The air will absorb all the moisture it can hold; therefore, fresh air should be forced to circulate to remove water vapor and carry moisture away from the food being dried. The force of the circulating air should not be so strong that it can blow the dried food off the rack.

Methods of Drying

There are three methods commonly used for home drying. Sun drying, oven drying, and cabinet-type dryers with controlled heat and air circulation (referred to in this bulletin as dehydrators). Whatever the method used, the prepared food should be placed carefully on trays so that air can circulate around the product and between the trays.

Sun Drying

Sun drying is the evaporation of water from products by sun or solar heat, assisted by movement of surrounding air. To be successful, it demands a rainless season of bright sunshine and temperatures above 98° F coinciding with the period of product maturity. Sun drying requires considerable care. Products must be protected from insects and must be sheltered during the night. This method is relatively slow, because the sun does not cause rapid evaporation of moisture. Reduced drying times may be achieved by using a solar dryer. Plans are available from your county Extension office.

To sun dry fruit

After fruit has been treated, place on trays one layer deep. Air circulation below as well as above fruit will speed up drying time.

- ⚙ Place in direct sun, turn occasionally. A light covering of cheesecloth or screen suspended above the food will keep it from insects. Place table legs in cans of water to prevent insects from crawling up into the food.
- ⚙ Several days in direct sun are sufficient to make fruit about two-thirds dry. At this stage, stack the trays in the shade where there is good air circulation and continue drying until leathery.

To sun dry vegetables

Submit vegetables to recommended treatment. Spread in thin layer on trays.

- ⚙ Place in the direct sun, turn occasionally.
- ⚙ Expose the trays to the sun, but only for one or two days. Direct sun on vegetables can cause sunburn or scorching. Drying can be completed in the shade.

Vine dried vegetables

Beans and peas that are allowed to dry on the vine need to undergo a pasteurization process for insect control. Freeze 48 hours, or spread the dried product one layer thick and heat in a 150° F oven for 30 minutes.

To sun dry jerky

Sun drying of meat as rapidly as necessary to avoid food poisoning can be difficult. The use of a dehydrator or oven is recommended instead.

- ⚙ Only sun dry meats that have been treated with curing salts containing nitrates and/or nitrites.
- ⚙ Cover meat with suspended cheesecloth or mesh to keep off flies.

Air Drying

Air drying is an alternative to sun drying for such products as herbs and chili peppers. The material is tied into bunches or strung on a string and suspended out of the sun until dry. This can be in a shady porch, shed or corner of the kitchen. Enclosing produce in a paper bag protects it from dust and other pollutants. Some herbs can be dried simply by spreading on a dish towel or tray and leaving on the counter for 2 or 3 days.

Dehydrators

Dehydrators with thermostatic controlled heat and forced air circulation are available from a number of commercial sources. They can also be constructed from a variety of materials available to the home carpenter. Dehydrators require: 1) an enclosed cabinet, 2) a controlled source of heat, and 3) forced air to carry away the moisture. Venting to allow intake and exhaust of air is necessary.

Selection of a commercial dehydrator

Price is not a foolproof method of measuring the quality of a commercial dehydrator. In addition to reading sales promotion information on dehydrators, you can do some relatively simple testing yourself. Take matches and a thermometer with you to the store. The thermometer should measure temperatures from 130-180° F. Place the thermometer on one of the shelves inside a working dehydrator. Desirable dryer temperatures are 140 to 160° F. Controls to adjust temperature should be accurate. Uniformity of temperature inside the dehydrator is important if you wish to avoid having to rotate shelves during the drying procedure. Temperature uniformity can be measured by checking the temperature front and back, top and bottom of the dehydrator.

The air flow through the dehydrator is also important. Designs of dehydrators vary but all will have an air intake and exhaust. The intake for air is frequently on the bottom or back and the exhaust on the top or front of the dehydrator. With the dehydrator turned on, light a match or a candle and holding it in the outflow of air slowly move it toward the dehydrator. The air flow should blow it out at 2-4 feet from the exit port.

Oven Drying

Oven drying is harder to control than drying with a dehydrator; however some products can be quite successfully dried in the oven. It typically takes two to three times longer to dry food in an oven. Thus, the oven is not as efficient and uses more energy.

Use of oven for drying

Set the oven at the lowest setting, preferably around 150° F and leave the door open 2 to 3 inches (block open if necessary). A small fan positioned to the side of the oven door

blowing inward will help remove moist air. **CAUTION:** This can be hazardous in a home with small children. Convection ovens already have a built-in fan system.

Pretreatment of Fruits and Vegetables

Pretreatments for specific foods are shown in Tables 1 and 2. Never pretreat more of the product than the dryer will accommodate at one time.

Blanching

Blanching is the process of heating vegetables and some fruits sufficiently to inactive enzymes. This precooking treatment also reduces the number of spoilage microorganisms on the product, preserves or sets the color, checks ripening processes, and coagulates some of the soluble constituents thereby saving the vitamin content. Further, it relaxes the walls of the tissue so that moisture escapes more readily, helps retard undesirable changes in flavor during storage, and assures satisfactory restoration of the product.

You may blanch with steam, hot water (scalding), or in a microwave oven. Steaming is preferable to scalding because some of the nutrients that are water-soluble can be lost in the blanching water. Steaming retains these nutrients to a greater degree. Microwave blanching will save time when small batches need to be blanched.

Steam blanching

- ⚙ Use a kettle having a close-fitting lid and a wire basket or sieve so placed in the kettle that the steam will circulate freely around the vegetable. Water should not touch the product.
- ⚙ Have the water boiling briskly before putting the prepared vegetable into the kettle. Be sure to have enough water so that you do not run out during the process.
- ⚙ Place a layer of vegetables in the steamer not more than 2-1/2 inches deep.
- ⚙ Steam the vegetables until each piece is heated through and thoroughly wilted.
- ⚙ Test for doneness by removing a piece from the center of the steamer and pressing it. It should feel tender but not completely cooked. It is better to overcook than to undercook.
- ⚙ Remove from steamer, and absorb surface moisture with clean dish towels or paper toweling. Spread on trays and place in a dryer.

Water blanching or scalding

When scalding, use the same method as above except have enough water in the kettle to cover the vegetables. Bring the water to a boil and gradually stir in the vegetables. Scalding requires less time than steaming, but is more destructive to nutrients. Test for doneness and process as for steaming.

Microwave blanching

An alternative way of blanching small amounts of vegetables is to use a microwave oven. Microwave blanching may not be as effective as water blanching, but avoiding a hot pot of boiling water may be more important to you. Place the prepared vegetables in a covered casserole or a zipable plastic bag, add water if needed, and heat at 600-700 watts for the times provided in Table 1 or until inner part of product is hot but still firm. Time tables are based on about 4 cups of produce per batch. After blanching, the pieces should be hot throughout.

How to blanch vegetables in a microwave oven

1. Choose good quality fresh vegetables before blanching. Wash them thoroughly in cold water. Trim and cut.
2. If using plastic bags, line up enough microwave bags on the counter to accommodate amount of vegetables to be microwave-blanching. With the bags standing upright, fold back necks to form a cuff for easy filling.
3. Fill quart bags with about 4 cups of vegetables and a small amount of water. Fill bags only to the bottom of the neck. Seal bags, leaving a 1-inch center vent for steam. Or put 4 cups of vegetable in a casserole, add water and cover.
4. Microwave bags or casserole one at a time at HIGH according to times specified on chart. With an oven mitt, remove bag or casserole from oven. Stop the cooking action by dumping the produce immediately into ice water.
5. Drain blanched vegetable, pat dry with paper toweling, and spread on drying rack.

Crazing

Some fruits (such as prunes, plums, cranberries, blueberries, and grapes) have a natural protective wax coating. If they are to be dried whole, it is best if these fruits are pretreated by dipping them in boiling water for 15-60 seconds according to the size and toughness of the skin, and then immediately dip in cold water. This process crazes the wax coating on the skin and allows the moisture to escape, thus speeding the drying time of the fruit. Unlike blanching, it is not desirable to have the heat penetrate to the center of the product.

Sulfur Treatments

Browning of fruit can be effectively controlled by the use of sulfur or sodium bisulfite.

Warning: sensitive persons with asthma should avoid the use of sulfur or bisulfite compounds.

It can cause some asthmatics to have an asthma attack.

Do not use a household oven to dry sulfited fruits. The sulphur fumes that form have an unpleasant odor and can be harmful to health.

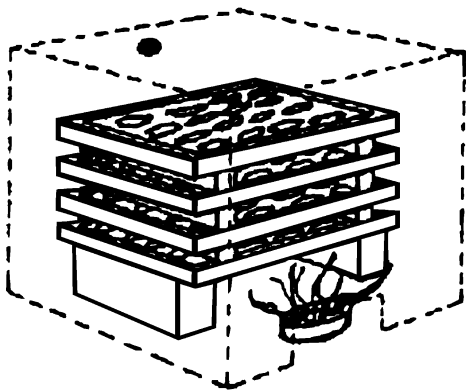
Sulfuring

Sulfuring has the advantage of producing an excellent quality product. It may be difficult to find sulfur; try pharmacies and stores that sell wine or beer making supplies. Fruit treated with sulfur will maintain color, flavor, vitamins A and C, and sulfuring will discourage insect infestation during drying. The heat during drying and subsequent cooking dissipates the sulfur.

As fruit is peeled, cored or pitted, put it in a salt solution (4 Tbsp. of salt to a gallon of water) to prevent discoloration.

Remove from the saline solution, and (without rinsing) drain thoroughly, pat with a clean towel to remove surface moisture. The fruit is then ready for the sulfur treatment.

Sulfuring should take place out of doors. Do not inhale the fumes.



A sulfur box or compartment is necessary. This may be a large cardboard box, provided it is large enough to cover the drying trays and the container for the sulfur. It must be relatively air-tight. A small opening must be provided near the bottom of the compartment for ventilation. Another small opening is necessary near the top of the compartment on the opposite side from the bottom opening.

The box or compartment should be tall enough to adequately cover the stacked trays and allow approximately 6 inches above the top tray—allow 1 to 1½ inches on three sides of the stack. It should also be large enough so that the sulfuring dish can be placed below but to the side or front of the stacked trays—not directly below them (to avoid burning or melting the bottom tray). There should be no less than 3 inches of space between the metal can holding the sulfur and the stacks of trays, and between the can and the inside of the carton or covering.

- ⚙ Place fruit on wooden trays having wooden slats or on the trays provided with a dehydrator, with the fruit not more than one layer deep. Sulfur corrodes metal, so it is important that wood or plastic trays be used. Place the fruit with the skin side down to prevent the loss of juices.
- ⚙ Blocks of wood or bricks placed on the ground may be used to support the trays. The lowest tray should be about 6 to 8 inches from the ground.
- ⚙ Stack the trays filled with fruit one on top of the other with blocks, wooden spools, bricks, or rocks between each one to allow for circulation between trays. They should be approximately 1½ inches apart.
- ⚙ Place the sulfur pan on the ground in front of the trays. This pan should be a clean metal container such as a tin can, shallow, but deep enough to prevent overflow—1 inch higher than the layer of sulfur. A dish made from a double thickness of aluminum foil may be used. The burning time of the sulfur will vary with ventilation, shape of container, weather conditions and other factors.

Sulfur that is free from impurities will burn properly. Sublimed flowers of sulfur or U.S.P. grade sulfur meet the standard of purity required. Garden dusting sulfur is not suitable.

Weigh the prepared fruit before placing on trays. Generally, if you are using a cardboard box to cover the trays, you will need 1 to 2 teaspoons per pound of fruit. If you have constructed a more airtight sulfuring box from wood, you need no more than 1 teaspoon of sulfur per pound of fruit.

- ⚙ Place the can of sulfur in front of the trays, on the ground near the lower opening of the box, and light the sulfur. A few drops of lighter fluid will facilitate lighting the sulfur. Sulfur burns best when powder is in a smooth layer not more than one-half inch deep. The depth, not the total amount of sulfur, determines the rate of burning.
- ⚙ Cover the stack of trays with the sulfuring box. Seal the bottom of the box by pushing dirt against the bottom edges. Leave the intake and exhaust holes open while the sulfur is still burning.
- ⚙ Close the intake and exhaust holes and start counting sulfuring time after two-thirds of the sulfur has burned. **NOTE:** Sulfur dioxide is created by combustion of the sulfur. The fumes must be given time to reach and penetrate the surfaces of the fruit on the stacked trays. See Table 2 for sulfuring times.
- ⚙ When time is up, lift the box off, tilting it away from you so that fumes don't come up in your face. Start drying the fruit immediately.

Sulfite solutions

Purchase U.S.P. (food grade) or Reagent Grade sodium sulfite, sodium bisulfite or sodium metabisulfite at pharmacies or where wine-making supplies are sold. Do not use bisulfate or products of Practical Grade.

Prepare a solution using one of the following formulas:

Sodium bisulfite: 1 tablespoon per gallon water (3/4 teaspoon/quart)

Sodium sulfite: 2 tablespoons per gallon water (1½ teaspoons/quart)

Sodium metabisulfite: 4 tablespoons per gallon water (2 tablespoons/quart)

Soak fruit 5 to 15 minutes depending on size. Drain; rinse lightly under tap water; spread on clean cloth or paper towels to remove excess moisture and dry.

Ascorbic Acid

Pure crystalline ascorbic acid

Pure crystalline ascorbic acid is a good anti-oxidant, but sometimes difficult to find. It is available through drugstores or chemical companies. For apples, dissolve 2½ teaspoons of crystalline ascorbic acid in each cup of cold water. For peaches, apricots, and pears, dissolve 1 teaspoon of ascorbic acid in each cup of cold water. One cup of solution will treat about 5 quarts of cut fruit. As the fruit is prepared (peeled, diced, sliced, etc.), place it into a large (1 gal.) plastic bag. Add the ascorbic acid solution. Shake thoroughly so

that all parts of the fruit are coated with the ascorbic acid solution. Drain well.

Ascorbic acid powders

These contain ascorbic acid and are found in grocery stores for use on “fresh fruit.” They do not work as effectively as pure ascorbic acid. Follow the directions on the package.

Fruit juice dips

Soaking the fruits into a fruit juice naturally containing ascorbic acid will help keep the natural color and prevent further darkening. These will also add their flavor to the product. Soak the fruit pieces 3-5 minutes, remove and drain well. Only use the juice twice before replacing. (The juice can be consumed.) Possible juices include orange, grapefruit, lemon, lime, or pineapple juice.

Vitamin C tablets

Crush to a powder and mix 1 teaspoon of 500 mg vitamin C tablets with 1 quart of water. Vitamin C tablets contain carriers which do not dissolve as well as pure crystalline ascorbic acid and may result in harmless white particles floating on the solution. Soak the fruit in the solution for 3-5 minutes.

Other Treatments

Saline dip

Dip sliced fresh produce in salt water solution (4–6 Tbsp. salt to 1 gal. water) for 10 min.

Honey dip

Dissolve 1/2 cup sugar in 1½ cup boiling water. Add 1/2 cup honey. Makes 2½ cups. Dip fruit in small batches. Allow fruit to soak 3 to 5 minutes. Remove with slotted spoon and drain.

Honey lemon dip

Slightly heat and dissolve 1/2 cup of honey with the juice of one lemon in 1/2 cup of water. Dip the fruit, then spread on drying trays.

Hot syrup

Combine one cup each of corn syrup, sugar and water. Bring to boil. Add fruit. Simmer 10-15 minutes. Drain well. Place on trays sprayed with oil to avoid sticking of fruit. Lift fruit gently from pan to tray. Syrup dip will increase the drying time. Final product is like a candied fruit.

Procedures for Products

Vegetables

Selection

Only fresh vegetables in prime condition can produce a good quality dried product. Wilted ones should not be used—deterioration has already begun. One moldy bean may give a bad flavor to an entire lot. If possible, gather the vegetables early in the morning, and start the drying process as soon as possible.

General procedure

SORT	Carefully discard any bruised or undesirable product
WASH	Carefully and thoroughly
PEEL	Slice according to recipe
TREAT	All vegetables, with the exception of onions, garlic, horseradish and herbs, are best if blanched before drying
DRY	Spread one layer thick on racks and dry

Table 1. Home Drying of Vegetables

For portable dehydrators, set temperature at 140° F.
Sun drying requires temperatures of 98° F or above.

Vegetable	Preparation	Blanching		Drying	
		Method (Choose one)	Time Minutes	Method	Time Hours
Artichoke, globe	Cut hearts into 1/8 inch strips.	Heat in boiling solution (¾ cup water, 1 Tbsp. lemon juice)	6-8	Dehydrator Sun	2-3 10-12
Asparagus	Wash thoroughly. Halve large tips.	Steam Water Micro: 4 Tbsp. water per 4 cups	4-5 3½-4½ 3-4½	Dehydrator Sun	1-3 8-10
Beans, green	Wash thoroughly. Cut in short pieces or lengthwise.	Steam Water Micro: 5 Tbsp. water per 4 cups	4-6 3-4 6	Dehydrator Sun	2½-4 8

Table 1. Continued.

Vegetable	Preparation	Blanching		Drying	
		Method (Choose one)	Time Minutes	Method	Time Hours
Beets	Cook as usual. Cool; peel. Cut into shoe-string strips 1/8 inch thick.	Already cooked; no further blanching required.	-	Dehydrator Sun	2-3 8-10
Broccoli	Trim, cut as for serving. Wash thoroughly. Quarter stalks lengthwise.	Steam Water* Micro: 4 Tbsp. water per 4 cups	4-5 2-3 5	Dehydrator Sun	2½ -4 8-10
Brussels sprouts	Cut in half lengthwise through stem.	Steam Water	6-7 4½-5½	Dehydrator Sun	2-3 9-11
Cabbage	Remove outer leaves; quarter and core. Cut into strips 1/8 inch 2u thick.	Steam until wilted Water Sulfite solution	2½-3 1½-2	Dehydrator Sun	1-2 6-7
Carrots	Use only crisp, tender carrots. Wash thoroughly. Cut off roots and tops; preferably peel, cut in slices or strips 1/8 thick.	Steam Water Micro: 5 Tbsp. water per 4 cups	3-4 3½ 4½-5½	Dehydrator Sun	2½-4 8
Cauliflower	Prepare as for serving.	Steam Water* Micro: 4 Tbsp. water per 4 cups	4-5 3-4 6	Dehydrator Sun	2-3 8-11
Celery	Trim stalks. Wash stalks and leaves thoroughly. Slice stalks.	Steam Water	2-3 2-3	Dehydrator Sun	2-3 8
Corn on the cob	Husk, trim.	Steam until milk does not exude from kernel when cut. Water Micro: 2 Tbsp. water per 2 ears**	5-8 4-6 4	Dehydrator Sun	4 8
Corn, cut	Prepare in the same manner as corn on the cob, except cut the kernels from the cob after blanching.	Micro: 2 Tbsp. water per 2 cups	4	Dehydrator Sun	1-2 6

Table 1. Continued.

Vegetable	Preparation	Blanching		Drying	
		Method (Choose one)	Time Minutes	Method	Time Hours
* Preferred method.					
** Omit water if corn is very fresh.					
Egg plant	Use the same directions as for summer squash.	Steam Water	3½-5 3	Dehydrator Sun	2½ 6-8
Horseradish	Wash; remove small rootlets and stubs. Peel or scrape roots. Grate.	None	-	Dehydrator Sun	1-2 7-10
Mushrooms ¹ (WARNING, see note.)	Scrub thoroughly. Discard any tough, woody stalks. Cut tender stalks into short sections. Do not peel small mushrooms or "buttons." Peel large mushrooms, slice.	Steam	2-3	Dehydrator Sun	3½ 6-8
Okra	Wash, trip, slice crosswise in ⅛-¼ inch disks.	Steam Water Micro: 4 Tbsp. water per 4 cups	4-5 2-3 3-3½	Dehydrator Sun	2-3 8-11
Onions	Wash, remove outer "paper shells." Remove tops and root ends, slice ⅛-¼ inch thick.	None	-	Dehydrator Sun	1-3 8-11
Parsley	Wash thoroughly. Separate clusters. Discard long or tough stems.	None	-	Dehydrator Sun	1-2 6-8
Peas	Shell.	Steam Water Micro: 4 Tbsp. water per 4 cups.	3-4 3 5	Dehydrator Sun	3 6-8
Peppers and pimentos	Wash, stem, core. Remove "partitions." Cut into disks about ¾ by ¾ inch.	Water	2-3	Dehydrator Sun	3½ 6-8
Potatoes	Wash, peel. Cut into shoe-string strips ¼ inch thick, or cut into slices ⅛ inch thick.	Steam Water	6-8 5-6	Dehydrator Sun	2-4 8-11

Table 1. Continued.

Vegetable	Preparation	Blanching		Drying	
		Method (Choose one)	Time Minutes	Method	Time Hours
<p>¹WARNING: 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.</p>					
Spinach and other greens (kale, chard, mustard)	Trim, wash very thoroughly.	Steam until thoroughly wilted Water Micro: use 8 cups, no water required.	2-2½ 1½ 1-1½	Dehydrator Sun	2½ 6-8
Squash: Banana	Wash, peel, slice in strips about ¼ inch thick.	Steam Water	2½-3 1	Dehydrator Sun	2-4 6-8
Hubbard	Cut or break into pieces. Remove seeds and cavity pulp. Cut into 1 inch wide strips. Peel rind. Cut strips crosswise into pieces about ⅛ inch thick.	Steam Water	2½-3 1	Dehydrator Sun	2-4 6-8
Summer	Wash, trim, cut into ¼ inch pieces.	Steam Water Micro: 4 Tbsp. water per 4 cups.	2½-3 1½-2 2½-3	Dehydrator Sun	2½-3 6-8
Tomatoes, for stewing	Steam or dip in boiling water to loosen skins. Chill in cold water. Peel. Cut into sections about ¾ inch wide, or slice. Cut small pear or plum tomatoes in half.	Steam Water	3 1	Dehydrator Sun	3½-4½ 8-10

NOTE: Micro = Microwave. Quantities of water and vegetables listed are for quart containers. Microwave times apply to most 600 and 700 watt microwave ovens with even cooking patterns which were manufactured about 1978. For optimum results, test temperature of vegetables with a temperature probe. Effective blanching occurs when internal temperature reaches 190° F.

Fruits

Selection

Fruits are easier to dry than most vegetables since the moisture content does not have to be reduced as much as for vegetables. The higher sugar content makes them easier to preserve and they give up water more easily than do vegetables. Apples, pears, peaches, apricots, cherries, plums, figs and berries are best fruits for drying. For best results, always select fruit that is ripe, but firm.

Preparation

To prevent discoloration, use stainless steel knives. Cut food into thin, even slices or uniform pieces for easier drying. Dried fruits are better products if they undergo one or more of the pretreatments. Blanching the fruit results in a darker, less flavorful and some less nutritious product than does sulfuring. It may also give a slightly cooked flavor. Sulfuring should not be used if the product will be consumed by someone with asthma.

Table 2. Home Drying of Fruits

Fruits are soft and pliable when dry. Berries will sound like a hard rattle.

		Average Drying Time		
Fruit and Preparation	Pretreatment (choose one)	Sun (days)	Oven* (hours)	Dehydrator* (hours)
Apples - Peel, trim, core and cut into slices or rings ¼-inch thick. Treat with ascorbic acid solution or fruit juice containing vitamin C to prevent browning.	- Fruit juice dip - Dip in sulfite solution** - Steam blanch 10 minutes - Sulfur** 45-60 min.	3-4	8-15	6-12
Apricots - Wash, do not peel. Cut in half and remove pit. Treat with ascorbic acid solution or fruit juice containing vitamin C to prevent browning.	- Sulfur** 1-2 hr - Fruit juice dip - Dip in sulfite solution** - Blanch in hot syrup	2-3	24-36	18-24
Bananas - Peel, slice, pretreat. Spray trays, cut in slices or lengths.	- Fruit juice dip - Honey dip - Dip in sulfite solution**	1-2	8-12	6-10

Table 2. Continued.

Fruit and Preparation	Pretreatment (choose one)	Average Drying Time		
		Sun (days)	Oven* (hours)	Dehydrator* (hours)
Berries, Strawberries - Wash, sort & leave whole except halve or slice strawberries.	- No treatment - Steam blanch ½-1 minute	1-2	3-6	2-4
Cherries - Wash, sort, leave whole or stem and remove pit.	- No treatment - Crack skins by dipping 15-20 seconds in boiling water then in cold water - Blanch in hot syrup	2-3	8-12	6-8
Cranberries -	- Crack skins by dipping 15-30 seconds in boiling water then in cold water.	2-3	8-12	6-8
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.	- Crack skin on whole fruit by dipping 30-45 seconds in boiling water then in cold water.	3-5	9-15	6-12
Grapes - Seedless - Wash, sort and stem. With seeds - Cut in half and remove seeds.	Seedless: - Dip in boiling water 15-30 seconds then in cold water to crack skins With seeds: - No treatment	2-4	10-16	8-12
Nectarines and Peaches - Peel if desired. Cut in half and remove pit. Leave in halves or cut into quarters or slices.	- Ascorbic acid solution - Fruit juice dip - Steam blanch halves and quarters 15-20 minutes, slices 5 minutes - Sulfur** 1-2 hours - Dip in sulfite solution**	3-5	20-30 halves 10-18 sliced	15-20 halves 8-16 sliced

Table 2. Continued.

Fruit and Preparation	Pretreatment (choose one)	Average Drying Time		
		Sun (days)	Oven* (hours)	Dehydrator* (hours)
<p>Pears - Peel, cut in half and remove core. Leave in halves or cut into quarters or slices.</p>	<ul style="list-style-type: none"> - Dip in sulfite solution** - Steam blanch 5-20 minutes depending upon size of pieces - Blanch in hot syrup - Ascorbic acid solution - Fruit juice dip - Sulfur** 1-2 hours 	3-5	20-30	15-20 halves
<p>Persimmons - Use firm fruit of long, soft varieties and fully ripe fruit of round drier varieties. Peel and quarter or slice using stainless steel knife.</p>	<ul style="list-style-type: none"> - Do not sulfur. - No treatment. - Steam blanch in hot syrup. 	3-5	15-24 quarters 8-12 slices	12-15 quarters 6-8 slices
<p>Plums - Wash, sort and dry whole if small, otherwise, into halves or slices.</p>	<ul style="list-style-type: none"> - Dip whole fruit in boiling water 30-45 seconds then in cold water to crack skins. - Steam blanch halves 15 minutes, slices 5 minutes. - Sulfur whole fruit 2 hours, slices 1 hour.** 	3-4	15-24 halves 8-12 slices	12-15 halves 6-8 slices
<p>Strawberries - See berries.</p>				

*Temperature: Use a preheated temperature of 160° F, dry foods for 2 hours and then decrease temperature to 140° F.

**Persons allergic to sulfur or sodium bisulfite should choose another pretreatment.

Banana chips

Select well-ripened bananas. Peel and cut into desired shapes. Bananas can be cut into rounds or strips. For crispier chips, slice into smaller pieces.

To prevent darkening, place sliced bananas in a fruit juice dip or honey dip for 3-5 minutes. Drain. For added flavor, bananas can then be dipped in sugar, jello or cinnamon. Since the sugar in fruits causes them to stick to drying racks, spray the drying rack with a vegetable cooking spray.

Place fruit in a single layer on racks. Dry in oven or dehydrator at 135-140° F. Allow 6-10 hours in a dehydrator and 8-12 hours in an oven.

Cherry raisins

Wash and pit pie cherries. Heat 2 cups of cherries and 1/2 cup of sugar until the liquid boils for 1 minute. (Cherry-sugar mixture will form own juice.) With a slotted spoon, transfer cherries to drying rack. Dry at 140-150° F until moisture is decreased so that you have 80% solids or until the cherries are firm and rubbery to the touch. You will have best results if you base the drying on having a final solids content of 80% and then either freeze the cherries or vacuum package to avoid mold growth.

Fruit Leathers

Fruit leathers provide nourishing snacks and are easy to prepare. This product can be made by pureeing fruit, either fresh or a drained, canned product.

Steps

The steps in making a leather are:

1. Wash fresh fruit and peel if desired. Remove pits and seeds. Slice or cube if the fruit is large.
2. Make a puree from the desired fruit. A blender or food processor can be used on fresh or precooked fruit. If a blender is to be used for fresh fruit, puree the fruit first and then bring the puree to a boil while stirring continuously. If a food mill or potato masher is to be used, it is best to cook fresh fruit with a small amount of water in a covered pan until tender first, then puree the fruit. The heat process will inactivate enzymes that can cause the leather to discolor. Canned fruit should be well drained. It is not necessary to heat canned fruit. The pureed product can be lightly sweetened if desired. Heavily sweetened fruits will remain sticky and will not dry well.
3. Spread the puree in a thin layer on a plastic film. The plastic film can be on a cookie sheet, a pizza pan, a oven-safe dinner plate or on some dehydrator racks. Make sure that the plastic sheet edges do not fold over and cover any of the puree. The puree should be about 1/4 inch deep.
4. Dry the leather in a dehydrator or oven. The leather is adequately dried when you can peel it from the plastic. The dried product should have a bright translucent

appearance, chewy texture, and a good fruit flavor. Leathers can be stored by rolling them up while they are still on the film and placed in a glass jar with a tight lid or plastic bag. They retain their color and flavor for several months at room temperature, but storage life can be extended by refrigeration or freezing.

Creativity in making fruit leathers

- ⚙ Different fruits can be blended together.
- ⚙ Seasonings such as cinnamon can be added—or powdered drink mixes or flavored gelatin products. Season to taste, but remember it will be more concentrated when the water has been removed.
- ⚙ Add undiluted, thawed frozen juice concentrates to add flavor.
- ⚙ Sprinkle puree with shredded coconut, chopped dates, other dried chopped fruit, granola, miniature marshmallows, chopped nuts, chopped raisins, poppy, sesame or sunflower seeds
- ⚙ Make a fruit leather, then lightly frost it with cream cheese. Roll it up and slice it for a pinwheel effect.

Applesauce makes a convenient leather base to which other flavors may be added. One example is Christmas Leather. Grape juice, orange, and berry frozen concentrates are possible variations.

Christmas leather

2 qt. home bottled applesauce or 32 oz. can applesauce
6 oz. frozen cranberry juice concentrate (thawed)
3-4 Tbsp. of sunflower seeds or chopped nuts (optional)

Combine applesauce and thawed, not reconstituted juice concentrate. Cover oven-resistant dinner plates with squares of plastic wrap. Spread 1 cup of the applesauce mixture on the plastic on each plate. Puree can be spread on plastic wrap on cookie sheets if preferred. Sprinkle surface with sunflower seeds or nuts if desired.

Dry in a food dehydrator or the oven at 150-160° F. (see oven drying below) for 6-10 hours or until it is dry enough so that it can be peeled from the plastic wrap. The final product may tend to be sticky due to the sugar concentration in the cranberry juice concentrate. Roll the leather up in the plastic wrap. If it is to be held for more than a few days, put the rolls of fruit leather in a plastic bag. Fruit leather made with nuts or seeds will not keep as long as plain leather. If they are to be held for more than a few weeks, refrigerate or freeze to control rancidity changes in the nuts.

Vegetable Leathers

Tomato vegetable leather

Small cherry tomatoes or varieties with high solid content are best for leathers. Wash thoroughly and remove stems and blemishes. Whirl prepared onion, green pepper and garlic in blender until fine. Add a few wedges of tomato to obtain juice, then add more

tomatoes to the desired amount. Add other seasonings (such as salt, pepper, oregano, thyme, cumin, chili, cloves, lemon juice) as desired. Dry.

Proportions will vary with personal taste. For a beginning, try one medium onion, one green pepper, and 1 garlic clove per 3 cups of prepared tomatoes. Celery can also be added.

This leather may be eaten as is, or used with the addition of water as an excellent tomato sauce. A little may be used in soups for flavoring.

Pumpkin leather

2 cups canned or fresh cooked and pureed pumpkin
1/2 cup honey
1/4 teaspoon cinnamon
1/8 teaspoon nutmeg
1/8 teaspoon powdered cloves



Blend ingredients well and dry.

Drying of Herbs/Seasonings

Mint, oregano, basil, parsley, marjoram, rosemary: Remove blemished leaves, tie together in bunches and hang upside down in warm, dry place where they will not be in direct sunlight, or spread on a dish towel. Remove leaves after dried.

Chives: Chop into the size pieces desired. Spread on a plate or cookie sheet and set out of the way in a warm room.

Dill seeds and other seeds: Spread on plate or screens and dry indoors.

Horseradish: Remove small rootlets, stubs. Peel or scrape roots. Grate then spread thin on trays and dry in dehydrator.

Garlic: Peel cloves. Slice or chop. Dry in a dehydrator, or if finely chopped, spread on plate or screen and dry at room temperature.

Citrus peel: Wash thoroughly. Remove outer 1/16 to 1/8 inch of peel and dry this portion. Avoid white bitter pith. Outer portion can be grated or sliced from fruit. Spread on plate.

General information

A microwave can be used to dry small amounts of herbs at a time. Put no more than 4-5 herb branches in the oven between two paper towels. Heat for 2-3 minutes on high. If not brittle and dry when removed from oven, repeat microwave drying 30 seconds more.

Store material in air-tight containers.

Testing for Dryness

You can determine when the product is dry by feel or by calculation of the amount of water remaining in the product.

By Feel

Fruits should be dried until leathery, but not hard. The time required for drying will range considerably. Fruit always feels softer and less dry when warm in the dryer, therefore remove a piece from the dryer and let cool before testing. The sample will show no moisture when cut and pressed. When a few pieces are squeezed together they fall apart when the pressure is released. They have a leathery or suede-like feel. High sugar fruits, like figs and cherries, will feel slightly sticky. Fruit leather can be peeled from the plastic wrap.

Vegetables are generally brittle or tough when they are dry enough. If there is a question as to whether vegetables are dry enough, reduce the temperature and dry the product a little longer, using a low temperature toward the end of the drying period. There is little danger of damage being done by this extra drying time.

By Calculation

For optimum plumpness of produce while maintaining safety, calculate the percent solids in the dried product to determine if the product is adequately dry.

1. Weigh the container that will be used on the scale. (Tray Wt.)
If your scales allows you to do so, adjust so that the container weight = 0.
2. Weigh the raw produce in the container (Product and Tray Wt.)
3. Calculate Raw Product Wt. (Raw Wt.):
Product & Tray Wt.
- Tray Wt.
Raw Wt.
4. Calculate desired final Wt. of dry product using the following formula
$$\frac{(\text{Raw Wt.}) \times (\text{Solids \%})}{90\%*} = \text{Desired Dry Wt.}$$

* 90% solids is a good value to use for vegetables.

Fruits are moister if 80% is used for calculation purposes. Do not use a lower percent value for solids.

For example: Want to dry cherries to 80 % solids (20% water).

Solids in raw cherries (from Table 3) = 14%

Container	= 5 oz.
Container + cherries	= 45 oz.
Wt. of raw cherries	= 40 oz.
$\frac{40 \text{ oz.} \times 14\%}{80\%}$	= 7 oz. final dry weight

The final weight of the cherries should be 7 oz. Since it will be weighted in a 5 oz. container, the weight will be 7+5=12 oz. If you adjusted scales so that container weight = 0, the final weight is 7 oz.

If fruit is dried to an 80% solids level, it will be safe from microbial spoilage with the exception of mold growth. To control mold growth, vacuum pack the dried fruit or freeze the product.

How to Vacuum Pack Dried Produce

Fill canning jars with dried fruit. With lid lightly screwed down, place jars in oven at 325° F for 15 minutes. Tighten lid when removed from oven. Test the lids on the dried fruit after it has cooled to see that you do have a vacuum seal.

Never vacuum pack your dried vegetable unless you know they are truly dry, either by drying to a brittle stage or by calculation. For vegetables, dry to 90% solids level.

Table 3. Percent Solids in Raw Fruit and Vegetables

FRUITS	Percent Solids	VEGETABLES	Percent Solids
Apples	16	Beans	10
Apricots	14	Beets	13
Bananas	26	Broccoli	11
Blue Berries	16	Cabbage	8
Coconut	49	Carrots	12
Cherries, Sour	14	Cauliflower	8
Cherries, Sweet	20	Celery	5
Figs	21	Corn	24
Grapes	19	Eggplant	8
Nectarines	14	Mushrooms	9
Peaches	12	Onion	9
Pears	16	Parsley	12
Pineapple	14	Peas in pod	12
Plums	14	Peppers, bell	7
Raspberries	14	Potato	21
Rhubarb	5	Spinach	9
Strawberries	9	Squash	6
		Tomatoes	6
		Turnip	7

Source: USDA Handbook 8-8, 8-11. Composition of Foods. 1982, 1984.

Conditioning or Curing of Dried Fruits and Vegetables

Conditioning

Pieces of food taken from the drying trays are not always uniformly dry. To condition, place cooled dried fruit loosely in large plastic or glass containers, about two-thirds full. Cover with a cloth and store in a warm, dry well-ventilated place. Stir and feel the food every day for a week. If there is evidence of moisture, return the food to the dryer. The food can be left in this way for one to two weeks. This assures an even distribution of moisture and reduces the chance of spoilage in the product.

If you dried the produce to a calculated final solids content, you can package without the conditioning step. Variations in moisture content will equalize between the pieces in the package.

Pasteurization

Foods exposed to insects before or during the drying process should be pasteurized to destroy insect eggs. Preheat an oven to 175° F. Spread the food loosely, not more than 1 inch deep, on trays. Do not put more than two trays in the oven at once. Heat brittle, dried vegetables for 10 minutes; heat fruits 15 minutes. Oven pasteurizing results in additional loss of vitamins, and may scorch food.

Freezer method: Seal dried food in heavy freezer containers (bags or boxes). Freeze for 48 hours to kill insects and insect eggs. Remove and let reach room temperature before packaging for permanent storage.

Storage

Dried products will keep for a year if sealed in moisture-proof containers and stored in a cool, dark, dry place. Heat and light have an adverse effect on the quality of dried foods. Dried foods must be protected from moisture absorption and from insect infestation. Glass jars, tin cans with tight-fitting lids and plastic containers are all satisfactory containers for storing dried foods. Containers should be filled as full as possible without crushing.

Drying Meat

Making jerky safely requires either the use of curing salts (containing nitrite) or enough heat in an oven or dehydrator so that the heat will kill organisms before they multiply. A

relatively high initial oven is recommended to kill microorganisms, therefore start at 160° F. The temperature can be decreased to 140° F if desired about half way thorough the process. The final preservation of the jerky will be by limiting the water available to microorganisms. Beef, mutton, venison, elk, chicken, or turkey can be dried without pretreatments. Bear meat and pork should be frozen for a month prior to making into jerky to kill any trichinae present. Use only lean cuts such as the round or chuck or turkey breast.

Raw meat is easier to slice if partially frozen. Slice with the grain of the meat. Trim all visible fat from the meat. High fat meats can become rancid.

Meat dried in a household oven can be place on cake racks on a cookie sheet in the oven or hung directly on the oven shelves. In the latter case, covering the oven floor with foil will facilitate clean-up.

Store the jerky in jars or plastic bags in a cool, dark location. If to be held for extended periods of time, refrigerate or freeze.

Method 1. Use of Commercial Curing Salts

- 1 pound lean beef or game
- 1 tablespoon commercial curing salt (ex. Morton Tender Quick mix)
- 1 teaspoon sugar
- 1/2 teaspoon black pepper
- 1/2 teaspoon garlic powder

1. Trim fat from meat. Cut strips along the grain, about 1/4 inch thick, 1-1½ inches wide and up to a foot in length.
2. In a small bowl, mix the curing salt and seasonings. Rub all surfaces of meat strips with cure mixture. Place strips in plastic bag and tie open end. Allow to cure in refrigerator for 1 hour. After curing, rinse strips under cold running water. Pat dry with paper towels.
3. Arrange strips in a single layer on greased racks in shallow baking pan. Meat edges should not overlap. Place in oven and heat at lowest temperature (150° F) with oven door slightly open, or use a dehydrator. Dry for 24 hours. Cool.

Place jerky in airtight jars or plastic bags. Store in a cool, dry place or freeze.

Method 2. Dry Rub Jerky

This recipe is similar to method 1 in that the seasonings are sprinkled dry onto the sliced meat. Since it does not contain any curing salts, the final color will be dark brown instead of reddish.

1. Slice 5 pounds lean meat into strips 1/4 - 1/2 inch thick, 1 to 1½ inches wide and 4 to 12 inches long.
2. Lay out in a single layer on a smooth clean surface (use cutting board, counter, bread board or cookie sheet).

3. If smoke flavor is desired, brush each strip of meat with 1/2 teaspoon liquid smoke in 2 tablespoons of water. Sprinkle strips liberally with salt on both sides. Add pepper to taste and garlic salt or powder if desired.

Other flavors. Instead of the garlic-smoke treatment, you may brush the strips before drying in such mixtures as teriyaki sauce, sweet and sour sauce, soy sauce, hot chili sauce, or Worcestershire sauce or combinations of these according to your choice.

4. Layer strips in a plastic bag, close and refrigerate for 6-12 hours.
5. Remove strips and blot dry with clean paper toweling.
6. Dry in oven or dehydrator 150° F.

Method 3. Jerky Marinade

1½-2 lbs. lean meat
1/4 teaspoon each of pepper
1/4 cup soy sauce
1 Tbsp. Worcestershire sauce
1/2 teaspoon onion powder
1/4 teaspoon each of pepper and garlic powder
1 teaspoon hickory smoke-flavored liquid

1. Combine all ingredients. Place strips of meat in a shallow pan and cover with marinade. Cover and refrigerate 1-2 hours or overnight.
2. Remove strips from the marinade, drain on absorbent toweling and arrange on dehydrator trays or oven racks. Place the slices close together but do not overlap.
3. Place the racks in a drying oven at 150° F. Dry until a test piece cracks but does not break when it is bent (10-24 hours). Pat off any beads of oil with paper toweling and cool.

Method 4. Teriyaki Marinade

2 lbs of lean meat
1/4 cup soy sauce
1 teaspoon freshly grated ginger root or 1/2 teaspoon ground ginger
2 teaspoons sugar
1 teaspoon salt

1. Combine seasoning, pour over meat strips in a large bowl and mix gently.
2. Cover and refrigerate for at least 2 hours or overnight.
3. Dry as in Method 3 above.

Method 5. Ground Meat Jerky

	Large Batch	Small Batch
Lean meat	10 lbs	1 lb.
Black pepper	2 Tbsp.	1/2 tsp.
Garlic powder	5 tsp.	1/2 tsp.
Sugar	3 Tbsp.	1¾ tsp.
Salt	1/2 cup	2½ tsp.

1. Chop or grind meat coarsely (once through a 3/8 inch grinder plate or equivalent) or buy lean ground meat.
2. Mix well with seasonings. It is important to distribute the seasonings uniformly; therefore, a household mixer is recommended.
3. Optional: Chop or grind meat finely (once through a 1/8 inch grinder plate or equivalent).
4. Place meat mixture on a sheet of waxed paper on a cookie sheet. Cover with another piece of waxed paper and flatten with a rolling pin. Rolled meat should be 1/8-1/4 inch thick.
5. Dry uncovered on cookie sheet in an oven or directly on rack in a food dehydrator at 150° F. When top of meat is almost dry, remove from cookie sheet and invert directly onto rack. Remove wax paper which had been on the bottom. If desired, mix 1 Tbsp. of liquid smoke with 1/4 cup water and brush this mixture over the meat at this stage. Continue drying.
6. After drying (6-12 hours) slice in strips of desired size.

Jerky made with this recipe will be brown. For red color, use a commercial curing salt (ex. Morton Tender-Quick salt) in place of regular salt.

Method 6. Deli Meat Jerky

Although jerky is traditionally made from raw meat, it can be made with much less effort using today's grocery store resources.

1. Chose lean, cured meat such as pastrami, corned beef, or ham. Sausages are high in fat and therefore not a good choice for drying. Have the meat sliced about 1/4 inch thick. Trim off any fat on edge of meat.
2. Spread the slices of meat over clean oven shelves close but not overlapping. The strips will need to dry from 8-12 hours depending on their thickness. The final product should be tough and leather-like. Blot any fat away while the meat is still warm.

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