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Drying vegetables

Pat Kendall and Lesta Allen¹

Quick Facts

Successful drying depends on heat, air dryness and good air circulation. Select vegetables at peak flavor and quality. Most vegetables should be blanched before drying to stop enzyme action. Package dried foods in tightly sealed containers and store in a cool, dry place.

- 1) *calorie content*—does not change, but is concentrated into a smaller mass as moisture is removed;
- 2) *fiber*—no change;
- 3) *vitamin A*—fairly well retained under controlled heat methods;
- 4) *vitamin C*—mostly destroyed during blanching and drying of vegetables;
- 5) *thiamin, riboflavin, niacin*—some loss during blanching, but fairly good retention if the water used to rehydrate also is consumed; and
- 6) *minerals*—some may be lost during rehydration if soaking water is not used. Iron is not destroyed by drying.

For best retention of nutrients in dried foods, store in a cool, dark, dry place and use within a year.

Table 1: Yield of dried vegetables.

Produce	Amount purchased	Amount	
	or picked Pounds	dried product Pounds	Pints
Beans, lima	7	1¼	2
Beans, snap	6	½	2½
Beets	15	1½	3-5
Broccoli	12	1¾	12-15
Carrots	15	1¼	2-4
Celery	12	¾	3½-4
Corn	18	2½	4-4½
Greens	3	¼	5½
Onions	12	1½	11½
Peas	8	¾	1
Pumpkin	11	¾	3½
Squash	10	¾	5

Source: *Drying Foods at Home*, Mrs. Marjorie M. Phillips, Cooperative Extension Service, University of Arkansas, Little Rock, Arkansas 72203.

Drying Trays

Selection or construction of trays for drying can be simple or involved, depending on the

Drying is one of the oldest methods of food preservation. Sun drying dates back hundreds of years. Drying preserves foods by removing enough moisture from food to prevent decay and spoilage. Water content of properly dried food varies from 5 percent to 25 percent depending on the food. Successful drying depends on:

- enough heat to draw out moisture, without cooking the food;
- dry air to absorb the released moisture; and
- adequate air circulation to carry off the moisture.

When drying foods, the key is to remove moisture as quickly as possible at a temperature that does not seriously affect the flavor, texture and color. If the temperature is too low in the beginning, microorganisms may grow before the food is adequately dried. If the temperature is too high and the humidity too low, the food may harden on the surface. This makes it more difficult for moisture to escape and the food does not dry properly.

Although drying is a relatively simple method of food preservation, the procedure is not exact. A "trial and error" approach often is needed to decide which techniques work best.

Nutritional Value of Dried Foods

Drying, like all methods of preservation, can result in loss of some nutrients. Nutritional changes that occur during drying include:

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amount and type of food to be dried. Good air circulation without reaction between food and trays is most important. For small amounts of food and trial runs, cheesecloth or synthetic curtain netting stretched over oven racks, cake racks, broiler racks or cookie sheets work well (attach with clothes pins).

If large quantities of food are to be dried, consider shallow wooden trays with slatted, perforated or woven bottoms. These can be used for sun, oven or room drying. Use wooden fruit crates or make tray frames from soft lumber. Use thin wooden slats or dowels placed one-fourth inch to one-half inch apart, strong curtain netting or stainless steel screening for tray bottoms.

Do not use galvanized screening. It has been treated with zinc and cadmium, which can cause a harmful reaction when in contact with acid foods. Other metals such as aluminum also are not advisable because they may discolor and corrode with use. If used, line with cheesecloth or synthetic curtain netting to keep food from touching the metal. This liner also helps keep foods from sticking to trays and pieces of food from falling through.

Wash trays in hot, sudsy water with a stiff brush. Rinse in clear water and air dry thoroughly before and after each use. A light coat of fresh vegetable oil or non-stick substance will help protect wood slats and make cleaning easier.

If trays are used in an oven, they should be 1½ inches smaller in length and width than the oven dimensions to allow for good air circulation. When stacking trays, place blocks of wood (2 inches or more high), between trays. This promotes good air circulation.

Selecting and Pretreating Vegetables

Select vegetables at peak flavor and eating quality. This usually is just as maturity is reached. Select sweet corn and green peas, however, when slightly immature to retain their sweet flavor before their sugars change to starch.

Picking activates enzymes that cause color, flavor, texture, sugar content and nutrient changes in vegetables. To control such changes, prepare the produce immediately after gathering and begin processing at once. Thoroughly wash or clean produce to remove any dirt or spray. Drain thoroughly; shake leafy vegetables well. Sort and discard any food with decay, bruises or mold. Such defects may affect all pieces being dried. Follow pretreatment and preparation steps outlined in Table 2.

Pretreat all vegetables, except green peppers, chili peppers, mushrooms, horseradish, okra, onions and herbs by blanching in steam or boiling water (see Table 2). This slows or stops enzyme activity that can cause undesirable changes in flavor and texture during storage. Blanching also relaxes tissues so pieces dry faster. It protects vitamins and color and reduces time needed to refresh vegetables before cooking.

Steam Blanching: Steaming is preferred over boiling because it results in less loss of nutrients and flavor. To steam blanch vegetables:

- Put 2 inches or more water in a large kettle or pan.
- Fit some type of rack (wire, wood, tin cans opened on both ends) into kettle to keep vegetables above water.
- Heat water to boiling.
- Place prepared vegetables in wire basket or very open mesh or cheesecloth bag. Fill no more than 2 inches deep.
- Place filled basket or bag on rack; cover kettle and steam for one-half the suggested time.
- Check to see that all pieces are being reached by steam. Stir or shake if necessary.
- Replace cover and continue heating for remainder of time.
- Test vegetables by placing a piece between your finger and thumb. It should feel limp and heated through, but not cooked.
- Lift out vegetables and spread on clean cloth or paper towel.

Water Blanching: If steaming is not possible, vegetables can be precooked (blanched) in boiling water. Work with small amounts so water doesn't stop boiling. Watch closely and precook shortest time possible as follows:

- Fill large kettle one-half full with water and bring to a boil.
- Put no more than three quarts of the vegetable pieces in a cheesecloth or mesh bag. (A 36-inch cloth square gathered at the corners works well.)
- Dunk vegetable bag in boiling water, making sure water covers the vegetables. Shake bag so hot water reaches all pieces.
- Start timing as soon as vegetables are in boiling water. Water should not stop boiling. The more vegetables to be dunked at one time, the more boiling water needed.
- Heat for length of time in table.
- Dunk in very cold water to cool (same time as blanched).
- Drain on cloth or paper towel.

Microwave Blanching: Opinions differ on the use of microwave ovens for blanching. The major difficulty is achieving a uniformly blanched product. Large amounts are blanched more efficiently in steam or boiling water. Small amounts, however, can be quickly and easily blanched in the microwave oven.

Follow directions for cooking fresh vegetables except reduce cooking time by two-thirds to three-fourths. Stir well, midway through and at end of blanching time. Allow to stand one or two minutes until uniformly colored. Plunge vegetables into ice water for the same time as microwaved to cool. Spread on cloth or paper towels to absorb water. Fill trays and proceed with drying instructions.

Drying Methods

Arrange pretreated vegetables on drying trays in a thin layer, one-half inch deep or less. Dry in sun, oven, room or dehydrator as described below.

Sun Drying: The sunny, high, dry climate of Colorado is well suited for drying foods outdoors, although some color fading may occur. Also care

must be taken to avoid areas that are dusty, polluted or infested with insects.

Place trays of pretreated vegetables in direct sun in a flat or tilted position that allows air to circulate around and underneath. To protect from insects, place netting or screening on both sides of tray without touching food.

Stir or turn food several times each day to help even drying. An electric fan directed onto food will hasten drying and help keep insects away. (For safety, fan needs a grid covering the blades).

When food seems about two-thirds dry, take trays indoors or into a shaded area. Continue drying until "done" (see Table 2). Do not allow sun to scorch or burn food. Sun drying may take 12 hours to four or five days, depending on the size of food pieces, amount of food on a tray, and weather conditions. If drying takes more than one day, bring trays in at nightfall to protect food from dew.

Oven Drying: Oven drying is faster than sun drying. Vegetables require three to 15 hours. Since food is not exposed to insects or dust, the end product generally is higher quality. However, oven drying must be done on a smaller scale than sun drying (4 to 6 pounds of fresh food at one time).

Either a gas or electric oven may be used; both require careful watching to prevent scorching. Proper temperature and ventilation are most important in oven drying. A too-low temperature at the beginning may cause food to sour; a too-high temperature may cause vegetable cells to burst and lose flavor, or the product may harden on the surface, making drying difficult in the center of pieces.

To oven dry, preheat oven at lowest setting (140-150° F); then adjust thermostat and prop open oven door to achieve a consistent oven temperature of 140° F. The open door also allows moist air to escape.

Place trays of prepared food in oven. Stack trays so there is at least 3 inches of clearance at top and bottom of oven and 2½ inches between trays.

Shift trays, top to bottom and front to back, every one-half hour. Stir food often if it is one-half inch deep (single layers need no stirring). Food scorches easily toward the end of drying time. Therefore, it is wise to turn heat off when drying is almost complete and open the door wide for an additional hour or so.

Room Drying: In dry climates, some foods can be dried satisfactorily in a warm room such as an attic or kitchen. Hang herbs, rootside up. Cover with paper bags if protection is needed from dust. String pumpkin rings and red chili peppers on cords and hang near the ceiling.

Trays of vegetables, half-dried in the sun or oven can be finished in a warm room. Stack trays 6 inches apart. Open screened windows to allow free circulation of air. Force a draft across food with an electric fan.

Solar and Dehydrator Drying: Solar and thermostatically controlled heaters and dehydrators can be purchased or home constructed at various costs. Cold frames, used by gardeners for

large sets, work well as solar dryers. For more information, see Service in Action 9.725 *Food Dehydrators—Selection and Use*.

Testing for Dryness

Foods should be dry enough to prevent microbial growth and subsequent spoilage. Dried vegetables should be hard and brittle.

Remove a small handful of food and cool for a few minutes before testing for dryness. When warm or hot, foods will seem more soft, moist and pliable than they actually are. See Table 2 for dryness test for individual foods.

Post-Drying Treatment

Conditioning: When drying is complete, some pieces will be more moist than others due to size and location during drying. Conditioning is a process used to distribute this residual moisture evenly in dried food, which reduces the chance of spoilage.

Pasteurizing: Foods that have been exposed to insects before or during the drying process should be pasteurized to destroy insect eggs and larvae.

See Service in Action 9.309, *Drying fruits* for instructions on conditioning and pasteurizing.

Packaging and Storage

Pack cooled, dried foods in small amounts in dry, scalded glass jars (preferable dark) or in moisture-vapor-proof freezer containers, boxes or bags. Metal cans may be used if food is first placed in a freezer bag. To protect from insects and reabsorption of moisture, seal lids onto containers. Wrap edge where lid meets container with a plasticized, pressure-sensitive tape or clean, 1-inch cloth strip dipped in melted paraffin. Bags may be heat-sealed or closed with twist ties, string or rubber bands.

Foods that seem "bone dry" when packed can be spoiled by reabsorption of moisture during storage. Moisture that collects inside glass jars or plastic containers can be noticed. If this happens and food has not molded, it can be rescued. Heat to 150° F for 15 minutes and reseal. Discard all food that shows signs of mold.

Label containers with name of product, date, and method of pretreatment and drying. Store in a cool, dry, dark place. Properly stored, dried vegetables keep well for six to 12 months.

Using Dried Vegetables

One cup of dried vegetables reconstitutes to about two cups. To rehydrate and cook leafy or tender vegetables (spinach, kale, cabbage, chard, tomatoes) cover with hot water and simmer to desired tenderness. Root, stem and seed vegetables (carrots, green beans, peas, corn) need to be soaked before cooking. Cover with cold water and soak one-half to 1½ hours, or cover with boiling water and soak 20 minutes to one hour. After soaking, simmer until just tender.

Dehydrated vegetables have a unique texture and flavor. They are best used as ingredients for soups, casseroles, sauces, stuffings and stews.

Table 2: Steps for drying vegetables. (See text for details.)

Vegetable	Preparation	Blanching Time* (mins.)		Dryness test**
		Steam	Water	
Asparagus	Wash thoroughly. Halve large tips.	4-6	4-5	Leathery to brittle
Beans, green	Wash. Cut in pieces or strips.	2-3	2	Very dry, brittle
Beets	Cook as usual. Cool, peel. Cut into shoestring strips 1/8" thick.	Included in cooking.		Brittle, dark red
Broccoli	Trim, cut as for serving. Wash. Quarter stalks lengthwise.	3-4	2	Crisp, brittle
Brussels sprouts	Cut in half lengthwise through stem.	7-8	5-6	Tough to brittle
Cabbage	Remove outer leaves, quarter and core. Cut into strips 1/8" thick.	3	2	Crisp, brittle
Carrots, parsnips	Use only crisp, tender vegetables. Wash. Cut off roots and tops; peel. Cut in slices or strips 1/8" thick.	3-4	4	Tough to brittle
Cauliflower	Prepare as for serving.	5-6	4-5	Tough to brittle
Celery	Trim stalks. Wash stalks and leaves thoroughly. Slice stalks.	2-3	2-3	Very brittle
Chili peppers, green	Wash. To loosen skins, cut slit in skin, then rotate over flame 6 to 8 minutes or scald in boiling water. Peel and split pods. Remove seeds and stem. (Wear gloves if necessary.)	None	None	Crisp, brittle, medium green
Chili peppers, red	Wash. String whole pods together with needle and cord or suspend in bunches, root side up in area with good air circulation.	None	None	Shrunken, dark red pods, flexible
Corn-on-the-cob	Husk, trim, blanch until milk in corn is set.	3-5	3	Brittle
Corn, cut	Prepare as for corn on the cob, except cut the kernels from the cob after blanching.	3-5	3	Brittle
Eggplant	Wash, trim, cut into 1/4" slices.	3-4	3-4	Leathery to brittle
Horseradish	Wash, remove small rootlets and stubs. Peel or scrape roots. Grate.	None	None	Brittle, powdery
Mushrooms	Scrub. Discard tough, woody stalks.	None	None	Dry and leathery
Warning: (see below)	Slice tender stalks 1/4" thick. Peel large mushrooms, slice. Leave small mushrooms whole.			
Onions	Wash, remove outer "paper shells." Remove tops and root ends, slice 1/8 to 1/4" thick.	None	None	Very brittle
Parsley and other herbs	Wash thoroughly. Separate clusters. Discard long or tough stems. Dry on trays or hang in bundles in area with good circulation.	None	None	Flaky
Peas	Shell.	3-4	3	Hard, wrinkled, green
Peppers and pimientos	Wash, stem. Remove core and seeds. Cut into 1/4- to 1/2-inch strips or rings.	None	None	Tough to brittle
Potatoes	Wash, peel. Cut into 1/4" shoe-string strips or 1/8" thick slices.	7-9	6-7	Brittle
Spinach and other greens (kale, chard, mustard)	Trim and wash very thoroughly. Shake or pat dry to remove excess moisture.	2-3 (until wilted)	2	Crisp
Squash, winter	Cut or break into pieces. Remove seeds and cavity pulp. Cut into 1" wide strips. Peel rind. Cut strips crosswise into pieces about 1/8" thick.	3	1-2	Tough to brittle
Squash, summer or banana	Wash, trim, cut into 1/4" slices.	3	1-2	Leathery to brittle
Tomatoes	Steam or dip in boiling water to loosen skins. Chill in cold water. Peel. Slice 1/2" thick or cut in 3/4" sections.	None	None	Crisp

*Blanching times are for 3,000 to 5,000 feet. Times will be slightly longer at higher altitudes, or if the quantity of vegetable is large.

**Dry in thin layers on trays to desired state of dryness.

***WARNING: The toxins of poisonous varieties of mushrooms are not destroyed by drying or by cooking. Only an expert can differentiate between poisonous and edible varieties.