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## Evaporation of Fruits and Vegetables in the Home

BY

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CORVALLIS, OREGON

Oregon Agricultural College and United States Department of Agriculture, Cooperating

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## EVAPORATION OF FRUITS AND VEGETABLES IN THE HOME

A. F. Barss.

The aim of this bulletin is to give in concise form sufficiently detailed information to enable anyone by following the directions to construct and operate an evaporator and satisfactorily to evaporate most of the fruits and vegetables used in the average home. No attempt will be made here to treat the subject from a commercial standpoint. For those interested in this larger phase of the work, the division of Horticulture, of the Oregon Agricultural College, will be pleased to make suggestions or answer any questions which may be asked.

### Evaporation

The **object** in evaporation is to preserve the fruits and vegetables through removal of moisture and to do this with as little change from the fresh state as possible in taste, odor, nutritive qualities, and general appearance. The particular method used may vary, but the object sought is the same in every case. In some instances there may be a change in color and flavor between the fresh and dried products, but the nutritive value, so far as has been determined, remains practically unaltered, there being merely a concentration of the food material through the removal of water.

The **principle** upon which the process of evaporation is based is that by removing enough of the moisture present in fruits and vegetables, the organisms which cause food to spoil cannot live and grow, thus bringing about preservation. Evaporation will also arrest the natural processes of ripening and decaying.

### Systems of Drying or Evaporation

There are three principal methods used in removing moisture from fruits and vegetables:

1. Drying by currents of air, either heated or not.
2. Drying by heat of sun.
3. Drying by heat, as in an oven or over a stove.

(1.) **Drying by currents of air** (frequently heated), caused by natural draft or produced artificially by fans, is an efficient means of evaporation, but is to be recommended generally only for commercial or community enterprises where considerable quantities of food are to be handled; since the cost of installation and operation would be more than for any other system.\*

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\*This was first described in O. A. C. Extension Bulletin 187, published in 1917, but now out of print.

(2.) **Sun drying**, which may be practiced in some parts of the State, has the advantage of being the least expensive method, and presents no danger of scorching. The absence of rain and dew and the presence of heat and dryness are essential, otherwise it will frequently be necessary to carry the product inside overnight, or cover over at times; and unless the drying is fairly rapid there is danger of spoilage before the loss of moisture is sufficient to prevent this.

Sun drying normally is much slower than the other methods of drying and in many instances is apt to give a poorer appearing product. Protection must be provided against insects and dust (screen or cheese cloth may be used). In some cases it will be found advantageous to place a glass covering of some kind over the material, allowing free circulation of air between the sash and food so that the evaporating moisture will not collect on the inside of the glass and drop on the food, but be carried off. The opening around the sides should be covered with netting. The use of glass as a cover will shorten the drying period very materially.

In sun drying, the prepared product is spread in fairly thin layers on sheets of paper or cloth, on wire netting, or on wooden trays; covered with a light netting to keep off insects; and then exposed to the heat of the sun. The material should be turned or stirred once or twice a day to give more uniform drying. To start and finish the drying in the open oven, or over the stove, where sun drying is to be used, will often save considerable time and give a better product. Green vegetables and berries will have a better color if dried in the shade.

Sometimes in connection with sun drying of fruit the latter part of the operation is in the nature of a curing. The trays of fruit, still somewhat moist, are placed in a stack one above another; covered, to prevent rain wetting the fruit; and allowed to stand that way for several days, until sufficiently dry to keep.

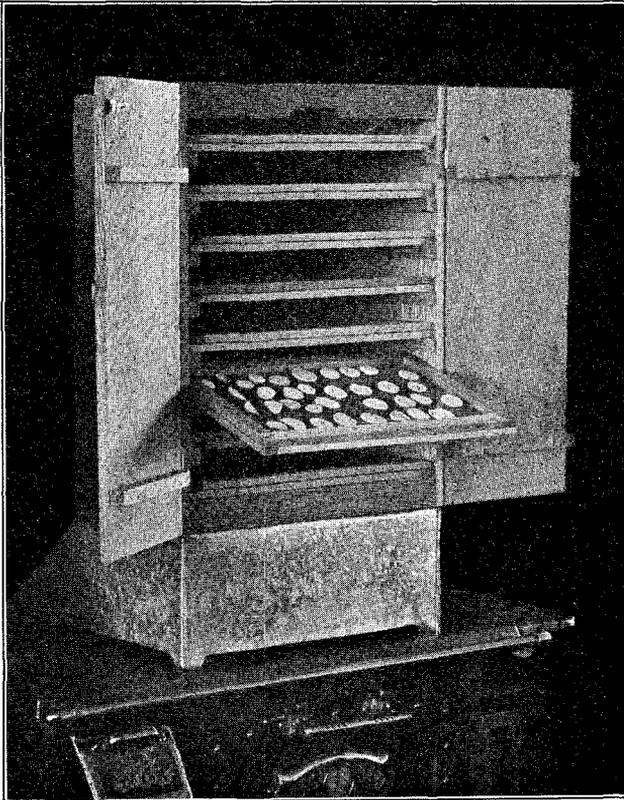
(3.) **Evaporation by artificial heat** is the method deserving to be generally recommended for the average home. The material may be placed on plates in a moderate oven with the door left partly open, or in some device so arranged above the stove as to make use of the heat radiated from the top. With an assured and easily regulated supply of heat, the work is more rapidly handled and the finished product more uniform than with sun drying.

### Home Evaporators

A home evaporator intended to use the heat from the kitchen range, oil or gas stove, laundry stove or heater, to be economical should be simple, convenient, and inexpensive to build and operate. It should be constructed with ample provision for the intake, discharge, and uniform circulation of heated air through or around the product being evaporated.

There are a number of small evaporators on the market, but the one here described and for which a detailed drawing is given was designed at the College some time ago,\* and has been found very efficient in actual use.

**Construction.** The cabinet is 12 inches wide by 21 inches broad by 27 inches high, open top and bottom to allow unimpeded air circulation, and contains eight interchangeable and reversible trays of small-mesh galvanized wire cloth, inserted between double wooden frames. The base of 27 gauge galvanized sheeting with re-enforced corners is nailed to the cabinet by  $\frac{5}{8}$  inch flanges turned in at right angles on the upper edges of the metal base. This base is 8 inches high by 21 inches wide by 21 inches long, this length allowing the foot to gather heat from under the warming oven. The opening at the bottom on all four sides allows free intake of air close to the hot surface of the stove.



\*Those interested in the construction of commercial evaporators are referred to O. A. C. Experiment Station Bulletin No. 145, "The Evaporation of Prunes," copies of which will be sent free to all residents of this State who request them. A moderate-sized or home-orchard evaporator is described in O. A. C. Extension Bulletin No. 213, copies of which are available for distribution.

For those who prefer it, it is easily possible with a little ingenuity to work out an inexpensive home-made drier of size and shape to suit the individual needs. Even an apple box will work, using large nails for legs and trays of wood made short so that by pushing every second tray through to the back there will be a continuous channel for heated air back and forth over the trays. A single tray of wire netting or a series of trays on a frame may be suspended over the stove. In some cases a deflector will be needed to prevent direct heat from the stove scorching the product. Although the cloth tends to retard the flow of the air, trays can be made of cheese cloth, burlap, or ordinary wire screening, except for the fact that acid fruits are apt to corrode the wire, unless it is galvanized. With these few suggestions, there ought to be little excuse for any home not having at least a small evaporator for the top of the stove.

**Operation.** To operate the evaporator here described, the freshly prepared material is spread on the trays evenly and not too deep, and placed on the upper slides of the evaporator, the trays with partially dried material being successively shifted to lower slides so that the finishing product is always nearer the stove; that least dried at the top.

#### General Directions for Evaporation

**What to Evaporate.** While anything may be dried, it is best usually to choose fruits having considerable solid matter such as apples, peaches, prunes, etc., and vegetables which are not too strongly flavored, such as green peas, green beans, corn, pumpkin, squash, and spinach. Very soft fruits are hard to dry, while some other fruits become too much changed in character to be desirable. Some berries, moreover, are too seedy to make a good product.

**Harvesting.** In all cases, regardless of the product being handled, the fruits and vegetables should be harvested when they have reached that condition in which they would normally be gathered to be prepared directly for the table without evaporation. They should then be handled as soon as possible after being picked in order that the resulting product may be of the best quality. All fruits should be fully ripe. Vegetables must be fresh, young, and tender. All decayed, rotten, moldy, or diseased specimens should be thrown out. Prunes and apricots are left on the tree until they fall naturally or on shaking the tree lightly.

**General Methods of Preparation.** The preparation needed before drying is often identical with that required before canning. Fruits generally need little attention unless they are dirty, or are to be peeled, while vegetables frequently require special treatment such as thorough scrubbing, peeling, trimming, slicing, dicing, blanching, etc., directions for which will be given later. Where sufficient quantities are being handled to justify the expense, it will save time and labor to invest in special vegetable cutters, peeling and coring knives, slicing machines, etc., which can often be procured through local hardware dealers. (A list of firms handling such supplies will be furnished upon application to the College.)

Directions for each product appear in the accompanying table and in special remarks under the heading "Supplementary Directions."

**Special Operations Sometimes Used in Preparation.** There are a number of special practices such as sulfuring, lye-dipping, lye-peeling, etc., which are often employed commercially, but since they are not essential to successful evaporation, they are generally omitted in home work. (Special directions for any of these processes will be sent upon request.)

**Blanching.** Although not essential, blanching is a practice recommended for most vegetables. It gives more complete cleansing, prevents discoloration, removes excess acid, strong odors and flavors, gives a more tender product, and hastens drying. Blanching is accomplished by placing the product in a wire basket, colander, or cheese-cloth bag, and scalding or blanching (not bleaching, but "blanching" as the term is used in canning) in steam or boiling water for a short time, i. e., generally from three to eight minutes, depending upon the kind of vegetables and their maturity, this process being followed by a rapid cooling by dipping for a moment in cold water to harden the surface and set the color. The material is then freed from surface moisture by placing between towels. This operation, useful for almost all vegetables, is particularly valuable when working with peas, beans, carrots, cabbage, turnips, parsnips, and potatoes. In the case of carrots, beets, potatoes, and tomatoes this may be used to help in removing the skin. It is worth noting, however, that this parboiling or blanching is often dispensed with where vegetables are being handled on a large scale in properly equipped factories.

**Cooking.** Some of the winter vegetables, such as beets and potatoes, may be given what amounts practically to a regular cooking, preferably in steam, prior to evaporation.

**Sugaring.** Many fruits will make an attractive and wholesome confection when the whole fruit, halves, quarters, slices, or chips are either dipped in a boiling sugar solution or sprinkled with sugar previous to or during the evaporation period. (This method cannot be recommended for use during the present sugar shortage.)

Table I gives general directions for the Evaporation of the individual fruits and vegetables.

TABLE I.—DIRECTIONS FOR EVAPORATING FRUITS AND VEGETABLES.

Fruits	General Preparation	Special Preparation	Size of Pieces	Temperature	Approximate
				degrees F. Start-Finish	yield dried Product %
Apples	Washed, pared, cored, trimmed		Whole, quarters		
Apricots	Not peeled, halved along suture, pitted		Rings or chips	125-150	12-14
Berries	Handled as little as possible		Halves	130-170	16-20
Cherries	Stemmed, sometimes pitted	Sometimes sugared	Whole	130-160	20-25
Peaches	Halved, pitted, may be peeled		Whole	140-160	25-30
Pears	May be peeled and cored if desired	Sometimes sugared	Halves or quarters	130-170	15-20
Plums	(See Prunes.)				
Prunes	Washed	Sometimes sugared	Halves or quarters	130-150	14-18
Quinces	(See pears.) Quinces seldom dried.		Whole or halves	130-170	28-33
<b>Vegetables</b>					
Asparagus	Wash, trim, cut into convenient lengths	Blanch 5-6	1-1½	120-140	8-10
Beans, green	Wash, snip, string, cut larger ones	3-6	Whole or 1-1½	100-120	10-12
Beets	Trim, wash, peel, slice	7-8 or cook	¼-½ slices	150-175	11-14
Cabbage	Trim, remove core, slice	5-10	Strings	140-160	9-11
Carrots	Trim, wash, peel, slice long or across	7-8	¼-¾ slices	120-150	10-13
Cauliflower	Trim, cut in pieces using only best parts	4-5 in steam	¼-¾ slices	130-140	9-11
Corn	Husk, silk, dry on cob or cut or scrap off	5 on cob	Kernels or on cob	180-190	20-25
Onions	Trim outside scales, slice crosswise	5	Strings or slices	140-160	12-14
Parsnips	Trim, wash, peel, slice	7-8 or cook	¼-¾ slices	120-150	12-14
Peas, green	Pick tender, shell, may be ground	3-5	Whole or ground	110-130	8-12
Potatoes	Wash, peel, slice or cube	2-3 or cook	Slices, cubes or ground	150-180	15-20
Pumpkin	Open, remove seeds and soft part, cut peel	3 or cook	½-inch chunk or paste	125-160	12-15
Rhubarb	Trim, peel, slice lengthwise or chunk	1-3 or omit	1 to 2	130-150	5-6
Squash	(See pumpkin)				
Tomatoes	Wash, peel, cut in two crosswise and squeeze gently				
Turnip	Trim, wash, peel, slice	1-3 before peeling	halves	120-140	6-8
		7-8 or cook	¼-¾ slices	130-150	8-10

For additional directions refer to the section headed "Supplementary Directions," which follows this table.

### Supplementary Directions for Evaporation

**Apples.** Fall and winter varieties are best for evaporating. Some oxidation or discoloration may be prevented by dropping the apples immediately after peeling into a weak brine. Sugared apple chips are delicious, wholesome, and not difficult to make. For rings, cut at right angles to the core.

**Apricots.** Royal and Moorpark, best (see peaches).

**Berries.** Black-cap raspberries and Loganberries are best to evaporate, although certain varieties of red raspberries and blackberries are good. Pick when firm-ripe, not mushy. Do not evaporate too far or they will not "come back" well on soaking, but be merely a mass of seeds.

**Cherries.** Dark, solid-meated, sweet cherries, best.

**Peaches.** Muir or any solid-fleshed variety. Usually unpeeled, but peeling will give a more attractive product. Cut along suture into even halves, stone removed, placed on trays cup-side up.

**Pears.** Peeling and coring will make a fancier product although they are generally merely cut in halves or sections. May be steamed or cooked a few minutes before drying.

**Plums and Prunes.** Thick-skinned, solid-fleshed varieties best for drying. If cut in half and pit removed, will dry more rapidly.

**Asparagus.** The base of the stalks will need longer blanching than the tips.

**Beans.** Green, string. To retain natural color, it is sometimes customary to add  $\frac{1}{2}$  teaspoon carbonate of soda to 1 gallon of water to the blanching water. Drying at too high temperature spoils both color and flavor.

**Beans.** Lima, may be picked when tender, shelled, and dried.

**Beets.** To retain color, do not trim tops or roots too close until after blanching. May be boiled until three-fourths cooked or blanched until skin slips, then peeled, sliced, and dried.

**Cauliflower.** The product will turn yellow, but will, in a measure, resume natural color on cooking. Sulfuring before evaporating for not over four to five minutes will tend to preserve the color. Evaporate rather slowly.

**Corn.** May be dried either on or off cob. The kernels may either be cut off, or be slit with knife and meat scraped out. After drying kernels, rub to loosen hulls and run through fanning mill. The blanching is needed to set the milk.

**Onions.** Peeling and slicing under water will make the work less distressing to the operator.

**Peas.** Can be ground and pulp dried.

**Potatoes.** Sometimes three-quarters cooked, generally with steam; mashed through a screen or sieve onto trays covered with cloth; and then evaporated.

**Pumpkin and Squash.** Sometimes a mashed product is obtained by steaming until soft, squeezing through a colander or sieve, and then drying on cloth-covered trays.

**Rhubarb.** Peeling off a strip of skin on each side or splitting stalk through middle will hasten drying. Do not use the leaves.

**Dried Peas and Beans** can easily be preserved without a special evaporator where wanted for food and not seed. A general rule is to collect before completely mature, although even at maturity they will be satisfactory. Dry or cure carefully either on the vine or picked off. Then shell by hand, flail, machine, or by tramping.

**Herbs and savory plants** may easily be dried to keep indefinitely either by suspending the plants in a warm dry place, or in evaporating outfits, or around a stove. By breaking or pulverizing, they can then be put into convenient form of a powder. (Good for flavoring soups, omelets, etc.)

**Flour Substitutes** are sometimes made from pumpkins, beets, and potatoes.

**Soup Mixture (Julienne).** Made by combining in desired proportion several kinds of dried vegetables such as carrots, potatoes, onions, celery, peas, etc., chopped fairly fine. (Broken slices and chips can often be used in this form.)

**Boiled dinner vegetables.** Mixtures of larger pieces of several kinds of vegetables.

#### Time of Evaporation

The only safe rule is to judge each lot separately and remove from trays when evaporation seems sufficient rather than after a certain amount of time has elapsed. Fruits containing sugar, in itself an antiseptic, do not need to have as large a percentage of moisture removed as do vegetables containing little or no sugar. On the other hand, it takes much longer to dry fruits than vegetables. For best results any product should be dried as rapidly as convenient without scorching.

#### Temperature of Evaporation

The temperature of evaporation will vary with the product. Generally speaking, fruits will stand a higher heat than vegetables, 140° to 165° or 180° is not dangerous with most fruits. With vegetables the risk of scorching is so great that most vegetables, especially at the beginning of the evaporation period, should not be given over 150°. From 120° to 140° is better. A thermometer is almost necessary and proves a valuable convenience to insure against scorching. A cylindrical thermometer may

be inserted between two trays by boring a hole in the side of the evaporator, or an ordinary thermometer may be laid in on one of the trays.

### When Evaporated

It is difficult to give directions sufficiently detailed to enable anyone to determine accurately when any given product may be considered "done," that is, to have lost the desired amount of moisture. Only individual experience in evaporating the different fruits and vegetables will be a safe guide for future work. A few general suggestions may assist.

Fruits such as apples, pears, peaches, and apricots should reach a stage, where on squeezing a handful, and then opening the hand, the pieces will spring apart. They should be rather tough, elastic, springy; a medium stage, not brittle, nor so moist that water can be pressed out from the end of a freshly cut piece. Berries should be dried until they tend to rattle somewhat, on the trays, but at the same time are still sufficiently moist to be springy, although not showing water on squeezing. Raspberries especially, if over-dried, will be too seedy and not rally well on soaking. If too moist, however, they will become moldy. Prunes should be firm, not sticky, show no water on pressing a freshly torn section, and separate clean from the pit. Cherries will tend to rattle somewhat on the trays but otherwise resemble prunes.

Vegetables must be dried harder than fruits or until thin slices will rattle on the trays and will snap on trying to bend, not appear leathery. Cubes of pumpkin or squash will be more spongy but should not show moisture on squeezing. Peas, green beans, and shelled green corn are dried until they rattle when stirred on the tray.

Avoid scorching or over-drying. By weighing before and after drying and comparing with the yields as given in the last column of the table a fair idea can be gained of the amount of moisture being removed. If the product after being removed from the dryer two or three days, shows signs of mold, it should be returned to the evaporator for a time.

### Yield

The yield of evaporated material from a given weight of fresh material will vary, depending on amount of moisture remaining, on kind and variety being dried, and on conditions under which grown (see right-hand column Table I for approximate yields).

### Sweating, Curing, or Conditioning

Sweating, curing, or conditioning is the placing of the evaporated product in boxes (protected from insects) where it can be stirred every day for a week or two until it has become uniform throughout the lot. If the material appears to be too moist or mold starts to grow on it, it will have to be dried further.

### Storage

When evaporation and curing are completed the material may be placed in the oven for a short time to kill any insect eggs present; then, for best results, the material should be packed in some insect and moisture-proof container, and stored in a cool, dry place. By putting the product in small packages, rather than large, there will be less danger of large quantities being lost in one lot from insect injury, and only so much of the dried material need be opened at any one time as will be used up within a few days. Pasteboard boxes with tight covers that can be sealed with melted paraffin or with adhesive tape, tight sacks with the end twisted and tied over double, and any tin and glass containers with tight covers will be satisfactory. The containers should be carefully labeled on the outside, indicating the contents so that it will not be necessary to break the seal before using.

### Insect Control

Insects, especially the larvae of the Indian Meal Moth, are the greatest source of spoilage in the finished product. If the evaporated material is heated thoroughly just before packing and then stored as here directed the danger of loss will be slight. If there are any signs of infestation at any time and this is noticed before very severe, dipping in boiling water for a few seconds or heating in a moderate oven at 140° for five minutes will kill all insect eggs and not injure the product.

### How to Use\*

To use dried fruits and vegetables, a general recommendation is to soak in cold water for several hours or over night, and then use in practically the same way as though fresh.

\* Special attention is called to O. A. C. Extension Bulletin No. 218, "The Use of Dried Fruits and Vegetables." Copies of any bulletins here mentioned will be sent free to all residents of Oregon who request them.