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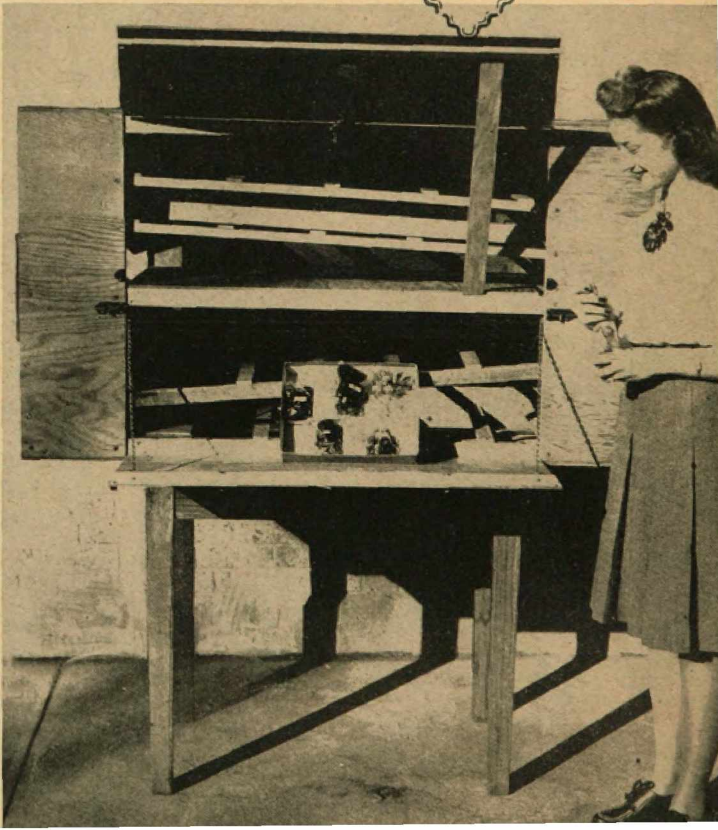
Making and Using a Food Dehydrator

W. E. PYKE and L. W. CHARKEY



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Making and Using a Dehydrator

W. E. PYKE and L. W. CHARKEY[1]

DEHYDRATION is a means of preserving food by drying it with artificial heat and forced air circulation. It is different from sun drying and evaporation, and it has an advantage over these methods in that it lends itself readily to quality control. When done properly, it conserves more food value, is more economical, and results in a more palatable product than other methods of drying.

Dehydrated food is 6 to 20 times lighter and 6 to 20 times less bulky than food processed in cans or frozen food, and thus it has "come into its own" in the war emergency for shipping to America's armed forces and allies. With the war-born shortage of metal for cans and of transportation space, dehydration has become important on the home front, too.

Research on dehydration was undertaken at the Colorado Agricultural Experiment Station as part of a national project to develop the best methods of thus preserving food. Dehydration has been shown to conserve as much or more nutritive value in food as other methods of food preservation, and it has several other obvious advantages. For instance, it is more convenient than other methods, in most cases it is more economical, and it allows a much wider latitude in the choice of storage facilities and containers.

Constructing a Dehydrator

Dehydration is simple. It consists merely in blowing heated air over fresh food to remove the moisture from it.

Consequently, construction of a dehydrator is simple. Three things are necessary: (1) A source of heat, (2) a fan to blow the heat over and around the food, and (3) a box in which the food can be placed and into which the warm, drying air can be blown. A thermostat to control the heat is desirable but not absolutely necessary.

Any arrangement which incorporates the three things just mentioned can be used for dehydration, and personal ingenuity in concocting such an arrangement can overcome almost any difficulty which may be met in the way of shortages of materials or appliances.

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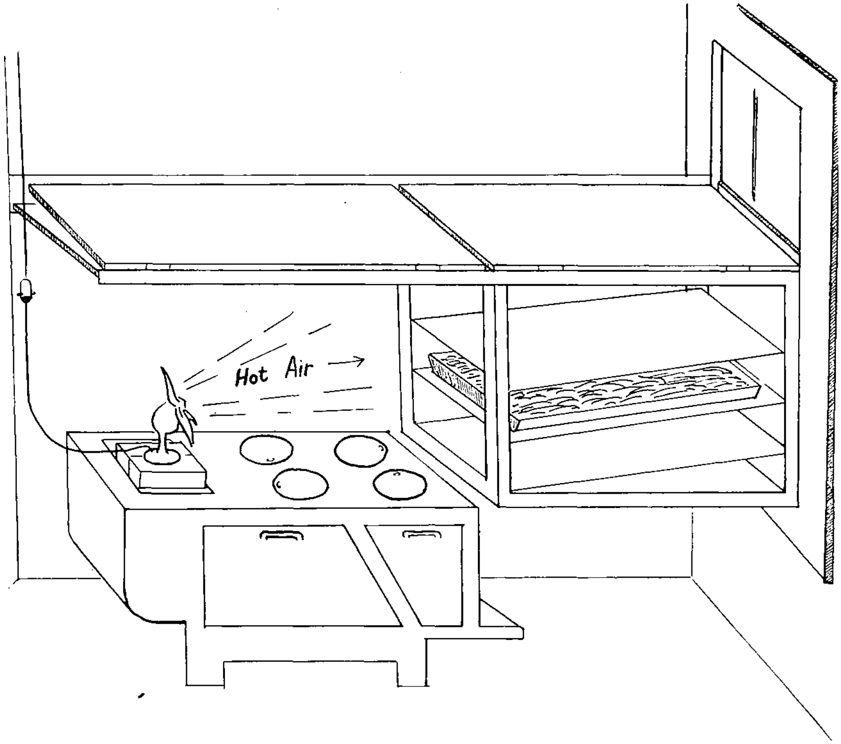
[1] Pyke, associate in home economics research; Charkey, assistant chemist.



This is dehydration in its simplest form—trays on which to place the food, heat, and a fan to blow the heat through the trays.

The family-size dehydrator given as an example in this bulletin was built of materials that were on hand or could be picked up locally. These consisted of a fan, an old thermostat, and two 9-ampere, 110-volt socket heaters that were already at hand, and lumber, a circuit-breaker switch, hardware, and wiring that cost less than $10.

Taking Inventory Before Construction

If the person who plans to build a dehydrator will take the following steps before he starts, he will save himself time and trouble:

1. Read through all directions for construction and use of the dehydrator.

2. Take inventory of available materials and possible alternatives for unavailable items.

3. Consider the most convenient place for the dehydrator and build it to fit that place.

4. Estimate what expert help will be needed in constructing the dehydrator and find out if that help is available.

5. Check costs so that part of the materials will not be already purchased if it is found that the cost of one or more items is prohibitive.

Size and Design

The size and design of the food dehydrator will vary according to construction materials and devices available for its manufacture, the type of heating equipment to be used, and the quantity and nature of food materials to be dried. For home manufacture and use, some modification of a tunnel dehydrator is the most practical. This may be constructed for one-family use or for cooperative or community use.

Plans for the construction of a family-size tunnel dehydrator and for a larger dehydrator[2] suitable for several families are given on the insert in the middle of this bulletin. Both have been constructed from locally available materials and devices. The general plan for their construction permits adaptation to available materials and devices.

Materials

Except for the appliances (heating unit, thermostat, fan, and screens) the dehydrator may be built entirely of wood.

Heating Unit and Control

Heat production may be from wood, coal, oil, gas, or electricity.

With wood or coal, the best arrangement is to install some type of radiator such as an old automobile radiator in the dehydrator and run hot water through it by piping it to a "monkey" stove or other small boiler. The radiator may be equipped with an ordinary automobile cooling system thermostat. A fan is then used to blow heat from the radiator through the tunnel of the dehydrator. If this arrangement cannot be made, the dehydrator can be installed over a stove or kitchen range and the heat allowed to come up through an opening in the bottom or end of the dehydrator. In this case the fan would blow air across the opening, forcing the heat through the tunnel. Heat may be controlled by varying the distance of the intake from the surface of the stove.

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[2] The larger dehydrator now in operation at the Experiment Station was built with the assistance and cooperation of R. D. Barmington of the Mechanical Engineering Section. It was constructed largely of metal so that it could be moved for considerable distances without damage.

Other types of heat may be supplied by an old burner, a gas unit heater, or electric heating elements. All of these lend themselves to control by means of a thermostat of the type used in household heating systems.

Thermostatic control of the heat is very desirable to prevent over-heating the food being dehydrated. Without a thermostat, heat control will require the constant personal attention of the operator. Any thermostat used should be checked against an accurate thermometer (a candy and jelly thermometer will serve), and the thermometer should be kept in the dehydrator while it is in operation so that the temperature may be checked from time to time.

Fan

Circulation of the air by a fan will usually depend upon electric power, although a gasoline motor may be used. In the latter case the dehydrator will have to be used out of doors or the exhaust carefully piped to carry off the carbon monoxide fumes.

Screens

Hardware-cloth screens are recommended for the bottoms of the drying trays and to support spun glass as a filter for air drawn in by the fan. Other types of screen will serve if hardware cloth is unavailable.

The Dehydration Process

Selection of Food

There are three important considerations in selecting food for dehydrating: (1) High-quality raw materials must be chosen; (2) the raw materials must have attained the proper stage of maturity (see the large table on the insert in the middle of this bulletin); and (3) the food must be fresh. The idea that it is possible to start with inferior materials and by some magic of processing obtain a product of superior grade is absurd.

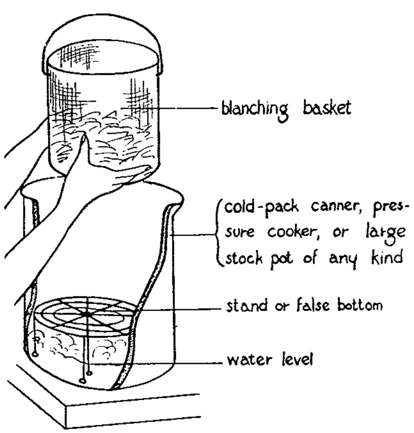
Preparation of Food

The food is washed, then brushed, scraped, peeled, trimmed, pitted, stoned, or stemmed, according to its nature, and finally subdivided (sliced, shredded, diced, quartered, or halved) prior to blanching. Table 4 on page 11 presents information which should be considered in this regard.

BLANCHING.—Blanching is the most important operation in the dehydration process. All vegetables and most fruits must be blanched. Enzymes, the natural bodies present in all living cells, continue to work after the food is harvested; they will cause the food to lose nutritive value rapidly and deteriorate generally in quality if they are not destroyed or their operation stopped. This may be done by blanching.

STEAM VS. DIP BLANCHING.—Heat in sufficient quantity rapidly accomplishes the necessary destruction of the enzymes. If the temperature of the food material is raised to 175° F. for only a short time, enzyme action ceases. This can be accomplished conveniently by steaming the food or dipping it in hot water. Steaming is recommended over dipping because considerably less loss of food value is caused by steam blanching than by dip blanching.

For blanching, a basket of hardware cloth or other wire mesh should be made to fit some large kettle or other similar container that is available. A cold-pack canner, a 50-pound or 100-pound lard can, or a large covered kettle will serve. Then 2 to 3 inches of water is placed in this container and brought to a vigorous boil. The wire basket containing the food to be blanched is set in the container on a rack that will hold it above the surface of the boiling water. To confine the steam, the container is closed but not tightly covered. If a large pressure cooker is available for this purpose, the cover should be used with the petcock open. The same equipment may be used for dip blanching by adding more water.



This drawing shows the arrangement for steam blanching.

Blanching time should be sufficient to raise the center temperature of the food to 175° F. Specific directions are given in the large table on the insert. After blanching, the food is spread upon trays and placed in the dehydrator.

Dehydrating

Dehydration time will vary with the sizes of pieces being dehydrated and the degree of air circulation. While some foods may be dehydrated in 4 to 6 hours, others may require up to 36 hours. When vegetables become hard, crisp, or brittle they have reached a satisfactory degree of dehydration, for their water content is below the danger line for spoilage. Fruits that are satisfactorily dehydrated are tough and very "chewy." Upon inspection the centers of the thicker pieces should show approximately the same degree of dehydration as the thinner sections.

Storage

CONTAINERS.—Dehydrated food may be stored in old syrup pails or shortening pails tightly covered, in covered fruit jars, or in moisture-proof paper or film, suitably coated vegetable parchment, or waxed paper bags.

PACKING.—The oxygen of the air will bring about gradual destruction of various nutrient materials. Therefore, if storage is to be for 4 months or longer it is desirable to drive the oxygen out of the container by placing a chunk of dry ice (free from frost) about the size of a walnut in the bottom of the container before the dehydrated food is placed in it. The container should then be closed but not sealed tightly until the gas escapes. The heavy carbon dioxide gas given off by the dry ice drives out the lighter air, bathing the food in an inert atmosphere. The container is then tightly sealed without reopening. When dry ice is used to exclude the oxygen, it is practical to allow sufficient quantities of dry food to accumulate so that packaging by this method will be economical.

TEMPERATURE AND LIGHT.—High temperatures and light also favor the destruction of nutrient materials in the food. Storage should be under cool, dry, dark conditions.

Detailed Directions

Detailed directions for selecting, preparing, and dehydrating various fruits and vegetables are given in the insert in this bulletin.

Using Dehydrated Foods

Dehydrated foods are quite palatable in their dehydrated state. However, they may be prepared for the table by rehydrating and heating. Rehydrating may be accomplished by soaking the food in plain cold water or in water to which has been added the salt or other seasoning desired. Soaking time necessary will vary from 1 to 10 hours, but should be long enough for the food to return approximately to its appearance when it was fresh.

Food Values of Dehydrated Foods

Some nutrients are lost from foods by any cooking or processing procedure. Examination of cooked food often shows that two-thirds or more of the vitamin content has been lost during the various stages of handling before it reaches the table. When the vitamin content of properly dehydrated and stored foods is considered against this background of experience, it becomes evident that food preserved by dehydration is a valuable source of the vitamins and other nutrients in the diet.

When advantages and disadvantages are considered, dehydration ranks high among the various methods of food preservation.

Vitamin C is the most unstable of the various vitamins. Unwise cooking procedures may quickly bring about its complete destruction. When proper dehydration procedures are followed, 60 percent or more of this vitamin may be conserved. With these same procedures the conservation of other nutrients besides vitamins is also high.

Results from Experiments

Reasons for some of the procedures and precautions emphasized in this bulletin are to be found in the tables on pages 9 to 12. These data were accumulated during our experimental investigations. They will serve to answer questions regarding variations in methods.

TABLE 1.—*Comparison of vitamin C (ascorbic acid) content of fresh and dehydrated carrots.*

Variety	Vitamin C (milligrams per 100 grams) in Fresh		Dehydrated		Loss of vitamin C during dehydration
		S*		S*	(percent)
Chantenay red cored	13.10	±3.29	67.63	±14.03	46.82
Chantenay long type	14.97	±4.91	73.93	±16.12	44.69
Danvers red cored	15.45	±4.07	68.11	±17.32	49.30
Imperator	14.64	±1.45	66.60	±11.69	43.14
Streamliner	17.24	±4.15	70.73	±23.50	49.54
Superb half long	14.70	±4.26	70.64	±12.00	45.70

Vitamin C is destroyed more easily during food processing than any other vitamin. Through careless handling of food materials it may all be lost. This table shows that more than half the original vitamin C content of vegetables can be conserved in the dehydration process. This compares favorably with the conservation of vitamin C obtained by other methods of processing.

* The standard deviations shown here for those interested in this technical phase include variations between rows and plots as well as cultural variations and field errors. They also lump together all processing and analytical variations and errors. Observations show that these carrot varieties are genetically far from uniform. Since this is true, it seemed best from a practical standpoint to combine all variations from whatever cause and present them as the standard error. From bunching size onward (¾-inch to 1-inch diameter) stage of maturity of the carrot does not seem to influence the ascorbic acid content of carrot tissue materially. These carrots were planted April 18, 1942, and were grown under irrigation. These series of samples were taken July 29 to August 1, 1942. Each mean value represents from 9 to 12 complete series of determinations.

TABLE 2.—*Comparison of blanching methods.* 1942 *mean percentage yields of dehydrated carrots from fresh carrots of common varieties grown in Colorado.*

Variety	Percentage yield in steam blanched	Percentage yield in dip blanched
Chantenay, red cored	10.3	8.5
Chantenay long type	11.2	8.6
Danvers, red cored	11.5	8.3
Imperator	12.5	8.7
Nantes	11.7	8.5
Streamliner	12.3	8.5
Superb half long	11.3	8.1

The most important step in vegetable dehydration is effective blanching. Nutrients will be poorly conserved without it. This table shows that steam blanching is usually better than dip or scald blanching because less of the food material is lost.

TABLE 3.—*Reduction in weight of various Colorado fruits and vegetables by dehydration.*

100 pounds of	Weigh this many pounds after being steam blanched and dehydrated	Condition
Beans, snap	3.9	Brittle
Beets, sliced, mean 6 varieties	14.9	Brittle to crisp
Broccoli, whole buds with 3 in. stems	14.2	Brittle
Cabbage, shredded, Copenhagen	10.4	Crisp
Carrots, sliced, mean 7 varieties	11.5	Brittle
Carrots, quartered, mean 7 varieties	11.9	Hard and tough
Cauliflower, buds with 2 in. stems	11.5	Brittle
Celery, stalks, Pascal	8.78	Tough to brittle
Celery, leaves, Pascal	8.41	Crisp
Onions, Ebenezer	15.1	Crisp
Onions, best Spanish Sweet	11.9	Crisp
Peas, Colorado No. 40	21.3	Hard
Peppers, Calwonder	5.3	Brittle to crisp
Potatoes, sliced, Red McClure	26.2	Brittle
Potatoes, sliced, Triumph	22.4	Brittle
Squash, cubed, Buttercup	13.5	Hard
Sweet corn, hybrid yellow	20.0	Hard brittle
Apples, peeled and cored, Jonathan	14.9	Springy to brittle
Cherries, pitted, Montmorency	15.6	Tough
Peaches, peeled, Elberta	20.5	Leathery
Plums, halved and stoned, Blue Damson	22.0	Leathery
Prunes, whole, Fellenberg, (lyedip)	34.5	Leathery
Pears, peeled, cored, and halved, Bartlett (dry and leathery)	18.6	Leathery

This table shows how much may be expected from 100 pounds of fresh prepared fruits and vegetables, and their characteristics after dehydration.

TABLE 4.—*Effect of different subdivisions on rate of destruction of vitamin A (carotene) in Imperator variety of carrots, planted April* 18, 1942, *dehydrated August* 11, 1942, *and stored in air in glass fruit jars until December* 1, 1942.

Subdivision	Vitamin A value (Micrograms per gram or parts per million)
Carrot meal	204
Sliced lengthwise	345
Quartered	765
Halved	835

Don't slice vegetables too finely for dehydration. As is shown in this table, the finer the subdivision the more rapid the loss of nutrients during storage. A slice 3/16 to 1/4 inch thick dehydrates rapidly. At the same time such a dehydrated slice reconstitutes with reasonable rapidity.

Store dehydrated foods in air-tight containers in a cool dark place. A sample of sliced carrots dehydrated in February 1942 was divided into two portions and stored 10 months at room temperature. The sample that was sealed to exclude contact with air assayed 1,222 micrograms per gram in December 1942. The other sample, placed in a loosely closed container but in contact with air, assayed 453 micrograms per gram.

TABLE 5.—*Vitamin A (carotene) values of six varieties of fresh and dehydrated carrots (micrograms of carotene per gram of sample or parts per million)*

Variety	Planted 4-18-42 Sampled 7-29-42	Planted 4-18-42 Sampled 9-17-42	Planted 7-3-42 Sampled 9-17-42	Planted 7-3-42 Sampled 11-19-42	Planted 4-18-42 Dehydrated 7-29-42 Stored in air in fruit jars until sampled 8-26-42	Planted 4-18-42 Dehydrated 10-23-42 Stored in air in fruit jars until sampled 11-23-42	Planted 7-3-42 Dehydrated 10-23-42 Stored in air in fruit jars until sampled 11-23-42	Planted 7-3-42 Dehydrated 11-19-42 Stored in air in fruit jars until sampled 12-1-42
Chantenay, red cored	74.0	154	96.5	196	681	1,137	704	1,430
Danvers, red cored	71.3	168	70.8	183	496	884	680	1,390
Streamliner	85.4	255	101.5	259	589	1,124	750	1,418
Imperator	74.4	191	90.0	282	547	1,010	698	1,390
Chantenay, long type	69.7	146	64.6	161	437	1,083	551	1,405
Superb, half long	71.2	168	83.0	209	492	1,049	636	1,330

The vitamin A value of carrots increases rapidly during the growing season. The food value of mature carrots is far greater than that of baby carrots. For dehydration the use of carrots of at least 2 inches crown diameter is advised.