STATION BULLETIN 423 SEPTEMBER 1944

# Home Fruit and Vegetable Dehydration

E. H. WIEGAND
F. E. PRICE
DALE E. KIRK
THOMAS ONSDORFF
ALYCE HOLMES

Oregon State System of Higher Education
Agricultural Experiment Station
Oregon State College
Corvallis

## FOREWORD

The housewife is handicapped in the preservation of perishable foods unless she has proper equipment for sterilization.

To assist these people who are handicapped in preserving their perishable foods this bulletin has been prepared. It contains working plans for the building of a simple yet effective dehydrator with directions for preparation, drying, packaging and storage as well as dehydration and cooking.

Wm. A. Schoenfeld

Dean and Director

# Home Fruit and Vegetable Dehydration

E. H. WIEGAND,[1] F. E. PRICE,[2] DALE E. KIRK,[3]
THOMAS ONSDORFF,[4] ALYCE HOLMES[5]

RESTRICTIONS that are being imposed in order to conserve essential materials for war needs make it imperative that methods of food preservation other than canning be adopted to assist in building up adequate food supplies. As pressure cookers are not available, many families are not in position to can vegetables properly. Glass jars, rubber jar rings, and many of the other accessories to canning are becoming scarce. The Army, the Navy, and the lend-lease program are taking large volumes of our commercially packed foods, making some of the important food items hard to obtain.

The Victory Garden Campaign will increase the raw material supply to most families, and provision should be made by these families to preserve the surpluses from their gardens. Where pressure cookers are not available to preserve these surplus vegetables, a simple small drying unit, used to conserve these products, can be made or obtained at a nominal cost.

## DEHYDRATION PRINCIPLES

The fundamental principle of preservation by drying is that of moisture reduction. When fresh fruits or vegetables contain their normal amounts of water, they are subject to spoilage. Removing this moisture preserves the material, because it removes the principal element necessary for the growth of organisms, such as yeasts, molds, and bacteria.

To remove moisture from fresh products, it is necessary to supply energy in the form of heat. This heat energy changes the water in the fruit or vegetable to a vapor that is carried away by the circulating air. All evaporation processes are dependent on three factors —heat, circulation, and humidity (or moisture) present in the air. Heat furnishes the energy to evaporate the water. The dryness of the air partly governs the rate of evaporation, and circulation further assists by carrying off the water vapor.

All products, when first placed in the dehydrator, give up their

[1]Food Technologist in Charge.
[2]Agricultural Engineer.
[3]Assistant Agricultural Engineer.
[4]Associate Food Technologist.
[5]Food Research Assistant.

moisture freely. Later when the moisture in the product is reduced to less than half, the rate of evaporation is materially reduced. This slowing up of the drying rate is due principally to the loss of liquid from the cells that slows up the flow of the moisture from the interior of the fruit or vegetable. Sliced or cut products will give up their moisture more freely than whole products. All raw products tend to resist excessive evaporation because the cells are still alive and active. After blanching, the cells lose their ability to resist and water passes through more freely. This is shown in blanched vegetables. Where whole fruits like prunes or cherries are dried, many hours of heating are necessary to reduce the moisture content to a safe preserving point. Here the outer skin tissue tends to slow down evaporation.

As temperature is the most important controlling factor, it should be maintained at 150°-155° F. to insure rapid evaporation. Higher temperatures than this tend to impair the quality of the finished product. When operating the dehydrator, be sure to maintain the temperature as close to 150°-155° F. as possible.

## CONSTRUCTION OF A HOME ELECTRIC FOOD DEHYDRATOR

The electric food dehydrator illustrated (Figure 1) has been developed for home dehydration of fruits and vegetables. The electric heating demand of 1,350 watts is such that it can be plugged into the ordinary home electric outlet. It requires a home- or office-type electric fan and since one probably cannot be purchased from dealers in wartime anyone planning to build this dehydrator should first make certain that he owns or has access to such a fan. The only other critical material required is a few feet of copper wire which probably can be found around most homes.

### Size and capacity

This size of dehydrator contains seven wooden trays, each approximately 18 inches by 30 inches making a total net tray area of nearly 25 square feet. This tray capacity should handle from 15 to 50 pounds of fresh food depending on the type of product being dried. It quite adequately serves three or four families for the dehydration of fruits and vegetables by following a rotated use program. Shredded or sliced vegetables require more tray area per pound than most fruits. A load of shredded carrots which would be about 20 pounds will dry in 7 hours, while a load of halved prunes or peaches having a weight of 40 pounds may require 15 to 20 hours for satis-

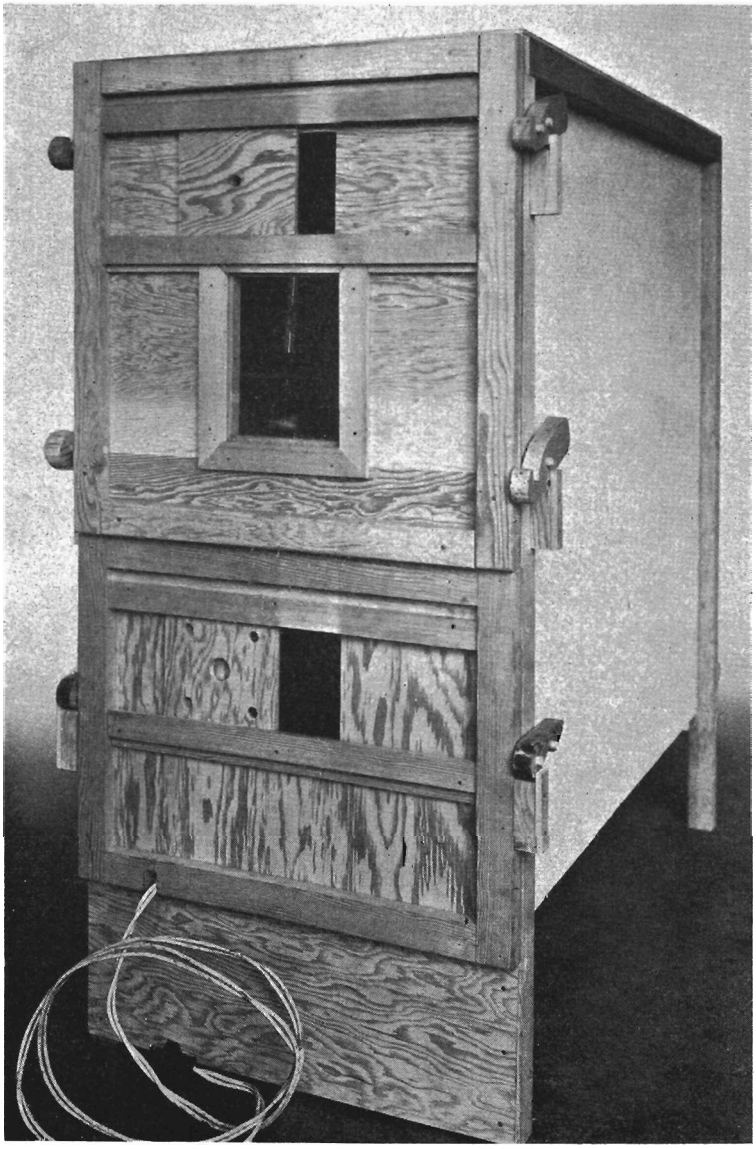

Figure 1. Home dehydrator.

factory drying, because of the larger size of each piece and the greater weight.

If a smaller-sized dehydrator unit is desired, the total length of the cabinet may be reduced if a corresponding reduction in the length of the trays is made. The size of the heating unit should be reduced so as to maintain the same relative heating capacity of about 60 watts for each square foot of tray area. All other dimensions should be kept as shown on the drawings to avoid operating difficulties.

## Heating units and fan

The electric heating unit shown in the drawings consists of nine 150-watt electric lamps screwed into standard sockets, making a total of 1,350 watts. This type of heating unit is suggested because in wartime more conventional heating units requiring nichrome wire cannot be purchased for civilian use. Other types of electric heating units would be equally satisfactory, but no others would be more efficient than the bank of electric lamps, provided the total wattage is the same.

An ordinary 10-inch home or office electric fan is recommended but it is assumed that persons planning to follow these plans in constructing a dehydrator already have a fan that can be used for this purpose. It is very doubtful whether such an electric fan can be purchased during the war period. The fan is required to circulate the air through the heating unit and over the fruit or vegetables on the trays. A somewhat larger or smaller fan would serve satisfactorily, but without a fan this design of dehydrator would not function properly. The fan and heating unit are mounted on a removable base as illustrated on the drawings. The electric cord to the fan and heating unit may be brought through a notch cut in the bottom edge of the lower door. Number 14 electric wire will be required. This heating unit and fan will constitute a full load for a residential electric circuit.

### Gas heating unit

An inexpensive gas heating unit can be made to serve in place of the electric heating unit although an electric fan would still be required. Consult your local gas company office for information on where to buy or how to construct a safe and satisfactory gas heating unit.

## Materials

Aside from the electric fan and a short piece of insulated copper wire the dehydrator is built entirely of noncritical materials. If $\frac{1}{4}$-inch plywood cannot be obtained, $\frac{3}{4}$-inch tongue and groove material may be used satisfactorily. If $\frac{3}{4}$-inch material is used instead of $\frac{1}{4}$-inch plywood the proper adjustments must either be made in the overall cabinet measurements or else narrower trays must be used.

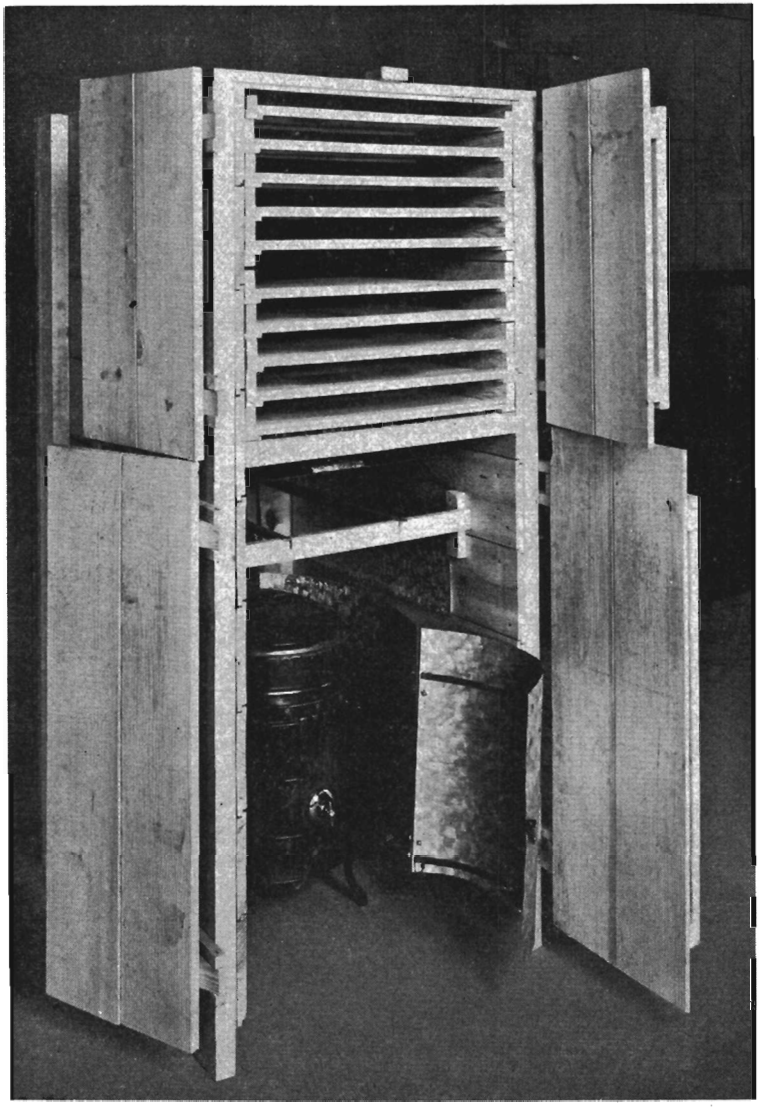

Figure 2. Drier designed for areas where electricity is not available. Adaptable for drying fruit or vegetables.

A bill of materials for the dehydrator unit is as follows:

BILL OF MATERIALS FOR THE DEHYDRATOR UNIT

2 sheets of ¼-inch plywood, 48" x 96"
2 sheets of ½-inch insulation board, 48" x 96"
24 feet of 2 x 2 in lengths divisible by 4 feet
48 feet of 1 x 2
90 feet of 1 x 1 in lengths divisible by 6 feet (make 1 tray support and 1 tray side from each 6-foot length)
300 feet of lattice (approx. ⅜" x 1⅜") in lengths divisible by 3 feet
30-inch wooden dowel ⅜" in diameter
10 lamp receptacles
9 150-watt lamp bulbs
20 feet of No. 14 or larger insulated copper wire
1 cord connector cup
1 dairy thermometer
Nails

## Construction

The general construction plan is to use plywood (or tongue and groove boards) which is nailed to four 2 x 2 posts to form the dehydrator cabinet. Two doors are provided at the front end to give access to the drying trays and to the heating unit. Ventilation openings are included in the door construction. Insulation board ½" thick is installed on the outer side of the side walls and on the inside of the back, top, bottom, and doors as shown on the drawings. This arrangement is used to simplify and improve construction.

A complete list of the parts that go to make up the dehydrator unit is given above. The part numbers found in the column at the extreme left of the sheet correspond to the circled numbers found on the drawings. If the unit is to be built entirely of these materials, the parts may all be cut to the size indicated and then assembled with the use of the drawings. Actual finished lumber sizes have been taken into consideration when determining the measurements indicated. For instance, a 1 x 2 board is taken as being actually ¾" x 1⅝", a 2 x 2 as being actually 1⅝" x 1⅝".

It should be noted that the two plywood sides (1), have a ¾" x 1⅝" notch cut in each upper corner to fit around the 1 x 2 ties at the top, front, and rear.

DOORS AND LATCHES. In place of metal hinges and door latches, which may be used if available, the self-tightening home-made wooden latches shown in the drawings have been tried and found very satisfactory. The latches should be cut out and shaped before the dowel holes are drilled for mounting them on the dehydrator. Full-size patterns for the wooden latches for both doors are provided on page 27 which can be cut out and used to outline the latches on

a piece of 1 x 2. The inner curve of the hook can be easily shaped by drilling as suggested on the patterns.

In order to operate properly, the top door latch must be heavier on the end opposite the notch, thus causing it to pivot on the dowel and rest against the stop. The stop (37) causes the latch to rest in a horizontal position when the door is removed. This keeps the latch in the most convenient position to receive the door when it is replaced.

The dowel holes for the door latches should be located by the following procedure:

1. Hold the door in the closed position with the top of the door level with the top of the cabinet.
2. Hold the latch in a horizontal position at the approximate location shown on the drawing.
3. Mark the two dowel holes required for each latch, one in the door and one in the cabinet, before moving the latch.
4. Remove the latch and drill the holes as marked.
5. Insert the dowels in the holes and place the latches on the dowels and nail the stops (37) in place. Make certain that the latches pivot freely.
6. Hang the top door on the latch hooks and note which hooks grip the door tightest. File or rasp the tightest hooks until all four corners of the door are held firmly against the cabinet.
7. The bottom door rests on the plywood front stiffener (7) and the hooks merely hold it in place after the door has been put into position.

TRAYS. Wood-slatted trays are illustrated in the drawings because of the probable continued wartime shortage of wire screen. It is recommended that the slats be placed $\frac{1}{8}$ inch apart. If wire screen can be obtained it would be satisfactory in this type of drier so long as no sulphuring is done on the metal screen trays. The tray supports on the side of the cabinet are spaced 3 inches on centers. The tray stops (40) should be nailed on the tray supports near the rear of the dehydrator at the exact location shown on sheet 2 of the drawings. When the trays are pushed back against this stop the top tray should be $10\frac{1}{2}$ inches from the door and $1\frac{1}{2}$ inches from the back. The bottom tray should be 6 inches from the front and 6 inches from the back.

## List of Parts for Electric Food Dehydrator

Part numbers in first column correspond to circled numbers in plan, Figure 3.

| *Part number* | *Number required* | *Name of part* | *Type of material* | *Size or amount* |
|---|---|---|---|---|
| 1 | 2 | sides | ¼" plywood | 40" x 42" |
| 2 | 1 | back | " | 21¾" x 41½" |
| 3 | 1 | top | " | 21¾" x 42¾" |
| 4 | 1 | bottom | " | 18" x 42½" |
| 5 | 1 | top door | " | 21¾" x 22½" |
| 6 | 1 | bottom door | " | 17" x 21¾" |
| 7 | 1 | front stiffener | " | 8" x 21¾" |
| 8 | 2 | sliding air controls | " | 6" x 6" |
| 9 | 1 | lamp receptacle base | " | 12" x 17¾" |
| 10 | 1 | fan base | " | 8" x 17¾" |
| 11 | 2 | sides | ½" insulation board | 39¼" x 39¼" |
| 12 | 1 | back | " | 18½" x 38⅜" |
| 13 | 1 | top | " | 18" x 41" |
| 14 | 1 | bottom | " | 18" x 41½" |
| 15 | 1 | top door | " | 21¾" x 22½" |
| 16 | 1 | bottom door | " | 16" x 17⅞" |
| 17 | 1 | bottom tray baffle | " | 18" x 30" |
| 18 | 1 | corner baffle | " | 12" x 18" |
| 19 | 1 | fan diaphragm | " | 15¼" x 17½" |
| 20 | 4 | legs | 2 x 2 dressed | 47" long |
| 21 | 2 | top side rails | " | 41" |
| 22 | 2 | top end rails | 1 x 2 dressed | 21¾" long |
| 23 | 1 | door stop | " | 18" |
| 24 | 2 | bottom end rails | " | 18½" |
| 25 | 2 | bottom side rails | " | 41" |
| 26 | 2 | top door framing | " | 22½" |
| 27 | 2 | top door framing | " | 18½" |
| 28 | 2 | bottom door framing | " | 17" |
| 29 | 2 | bottom door framing | " | 18½" |
| 30 | 2 | heating unit runners | " | 30" |
| 31 | 4 | top door latches | " | 6" |
| 32 | 2 | bottom door latches | " | 4½" |
| 33 | 14 | tray supports | 1 x 1 dressed | 41" long |
| 34 | 2 | fan diaphragm stops | " | 13" |
| 35 | 1 | fan diaphragm stops | " | 18" |
| 36 | 14 | tray sides | " | 30" |
| 37 | 6 | door latch stops | " | 3" |
| 38 | 147 | tray bottoms | lattice* | 17¾" long |
| 39 | 14 | tray runners | " | 30" |
| 40 | 2 | tray stops | " | 20" |
| 41 | 8 | air control guides | " | 18½" |
| 42 | 4 | top door latch guides | " | ¾" x 3½" |
| 43 | 2 | bottom latch guides | " | ¾" x 3¼" |
| 44 | 12 | door latch pins | ⅜" dowel | 2½" long |

* Approximately ⅜" x 1⅜".

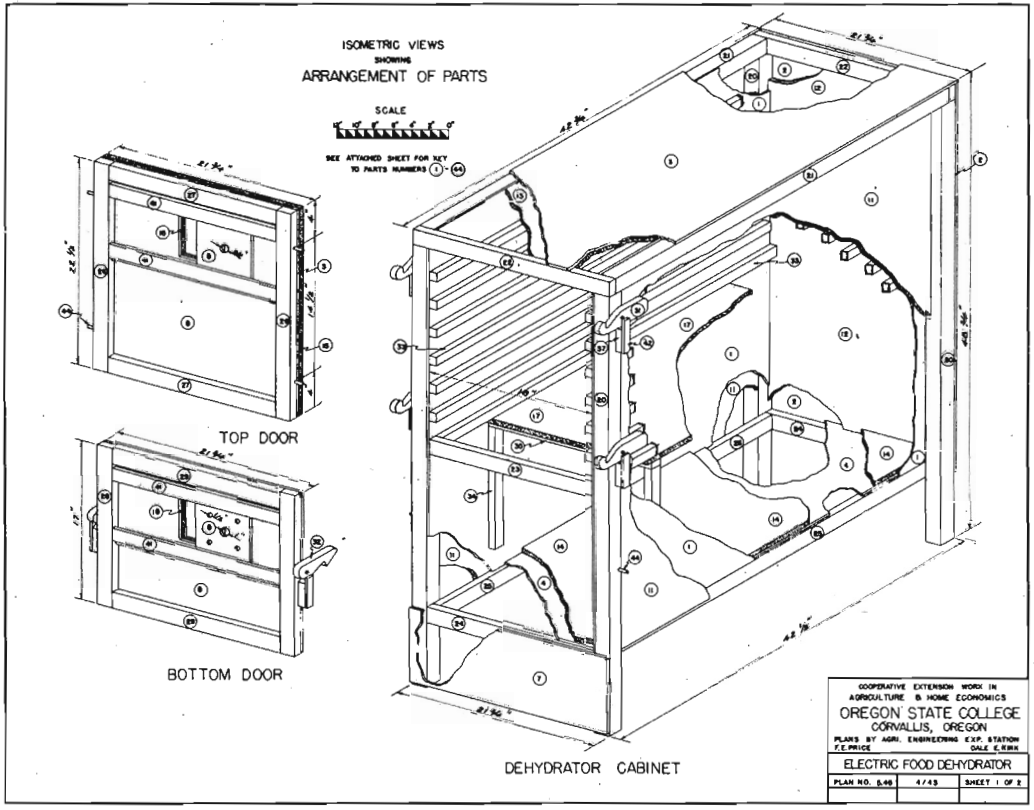
ISOMETRIC VIEWS
SHOWING
ARRANGEMENT OF PARTS
SCALE
SEE ATTACHED SHEET FOR KEY TO PARTS NUMBERS (1)-(44)
TOP DOOR
BOTTOM DOOR
DEHYDRATOR CABINET
COOPERATIVE EXTENSION WORK IN AGRICULTURE & HOME ECONOMICS
OREGON STATE COLLEGE
CORVALLIS, OREGON
PLANS BY AGRI. ENGINEERING EXP. STATION
F.E.PRICE
DALE E.EBEL
ELECTRIC FOOD DEHYDRATOR
PLAN NO. E-46
4/43
SHEET 1 OF 2

Figure 3a.

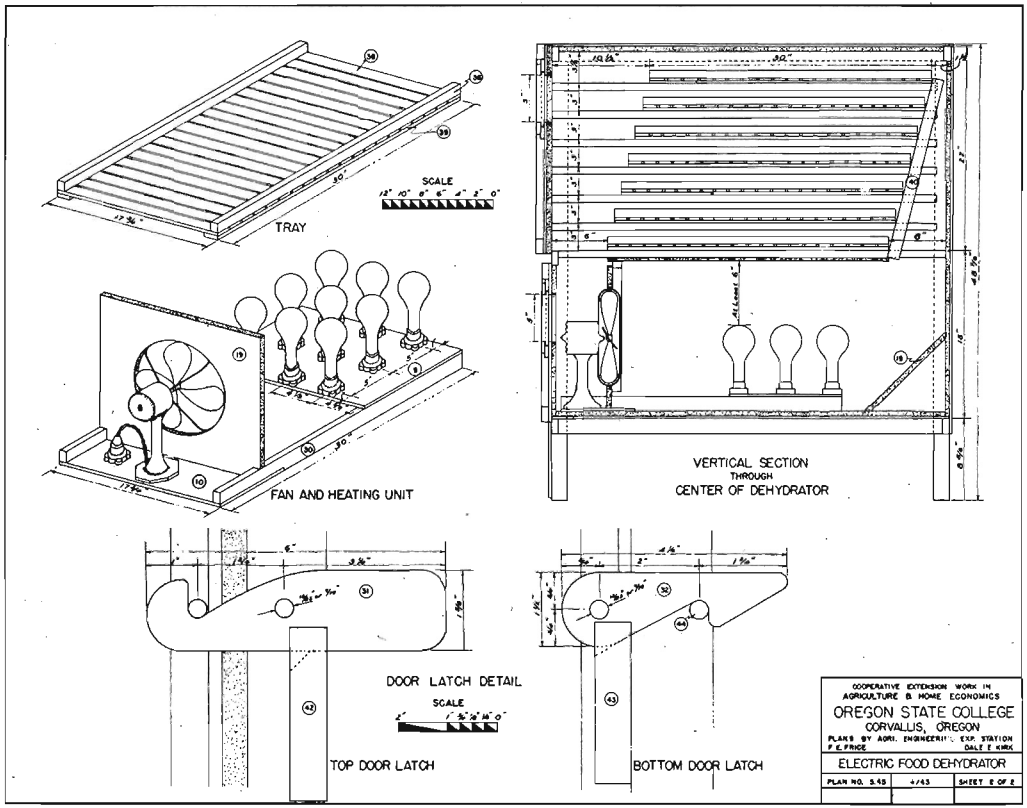
TRAY
SCALE
FAN AND HEATING UNIT
VERTICAL SECTION
THROUGH
CENTER OF DEHYDRATOR
DOOR LATCH DETAIL
SCALE
TOP DOOR LATCH
BOTTOM DOOR LATCH
COOPERATIVE EXTENSION WORK IN
AGRICULTURE & HOME ECONOMICS
OREGON STATE COLLEGE
CORVALLIS, OREGON
PLANS BY AGRI. ENGINEERING EXP. STATION
P.E. PRICE
DALE E. KIRK
ELECTRIC FOOD DEHYDRATOR
PLAN NO. 3.43
4/43
SHEET 2 OF 2

Figure 3b.

## OPERATING THE DEHYDRATOR

Some time before starting the drying operations, heat up the dehydrator. By the time the fruit or vegetables are prepared, the dehydrator should be up to a temperature of 150°-155° F.

After blanching (see pages 18-19 for blanching procedure), spread the hot vegetables on the tray immediately and place in the preheated dehydrator. It is important when operating the dehydrator to have the prepared blanched material go into the unit as hot as possible. This will prevent too great a fluctuation in the temperature of the drying unit.

To dehydrate fruits or vegetables quickly, careful attention should be given to the following items:

1. The temperature of the dehydrating unit should be established at 150°-155° F. Check the temperature of the unit at regular intervals to see that it is maintained throughout the drying period. The fresh air intake opposite the fan should be kept wide open during the entire dehydration period. The top door then becomes the actual regulator which is simpler than adjusting two doors. If all trays are loaded the top door should be opened about 2 inches for the first 30 minutes. During this time the temperature in the drying chamber will probably drop, but it will soon recover. At the end of 30 minutes reduce the top door opening to one inch and at the end of one hour reduce this opening to one-half inch. This latter position of the top vent can be continued until the temperature in the dehydrator approaches the maximum desired drying temperature. Then the top door opening must be increased to prevent excessive temperatures in the dehydrator or the heat input must be reduced.

   Inexperienced operators will wonder how to determine when the products have been dried sufficiently. Sliced and shredded vegetables should be dried until they are hard and brittle. Fruits should be dried until they are rubbery.
2. The sliced fruit and vegetable load should never exceed 1 pound per square foot of tray surface. To prevent wet spots spread the material evenly on the trays about 2½ to 3 pounds per tray.
3. The spread when halved fruit is used should not exceed 1½ to 2 pounds per square foot of tray surface—about 3 to 5 pounds per tray.
4. Maintain heat constantly at temperature 150°-155° F.
5. For the best results fill dehydrator gradually.

6. Reverse trays from end to end if necessary to assist drying.
7. Dry fruit until it loses enough moisture to become leathery. (See Table 2. If in doubt, dry further.) The center of the piece, when broken, should show no free moisture.
8. Dry vegetables until they lose enough moisture to become brittle and snap sharply in two when bent. Before making this test cool vegetable to room temperature.

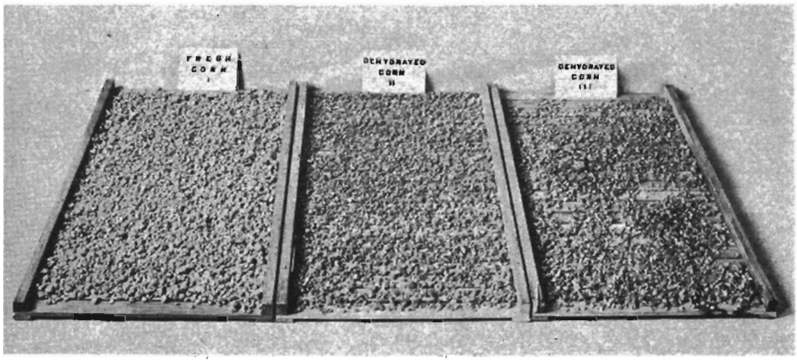


Figure 4. Load trays carefully with proper amount of raw materials. Spread evenly on tray to insure uniform drying. Note spread and effect in illustration.

## SELECTING THE FRESH PRODUCT

To insure success in the finished product, select fresh fruit or vegetables of good quality. Use only ripe fruit that has reached its full development and is in prime eating condition. Vegetables that are mature but still tender and succulent should be used. Overmature vegetables tend to be tough, stringy, and flavorless.

Varieties recommended for use in freezing as suggested in Extension Bulletin 623 are usually suitable for dehydration. Early morning harvest of vegetables while the products are fresh and succulent is recommended. Rapid handling then will conserve vitamins ordinarily lost through long holding and storage. Under no conditions should succulent vegetables be held longer than 6 hours after harvest before drying, and it is essential they be kept cool during this time.

Make your dehydration plans to supply a variety of those fruits and vegetables that will provide the greatest amount of nutritive material. Your selection of foods should include items that will give variety in color and flavor as well as nourishment.

## IMPORTANCE OF PROPER PREPARATION

Fresh fruit and vegetables contain many nutritive substances that are easily lost in storage, handling, and preparation. Conservation of these is important. Chief among these elements are vitamins, sugars, proteins, and minerals—all essential to the body. When preparing the products, certain steps are necessary to conserve some of these essential materials. Many, like Vitamin C, oxidize readily in the presence of air. Others, like sugar and minerals, dissolve in the washing or blanching procedure and are lost. With greater care given to each step in the preparation, more of these elements can be retained in the product.

## PREPARATION OF FRUITS FOR DEHYDRATION

Washing is the first step in preparation. After cleaning, some fruits, like apples, are hand-peeled, cored, and sliced. Others, such as apricots, are cut in half and the pit is removed. Peaches are usually cut, halved, and pitted. Peeling is optional; if peaches are sliced, they should be peeled.

Peeling such fruits as peaches is easily accomplished by immersing a small quantity of fruit in quite a large volume of boiling water. After the fruit is immersed in this water for 1 to 1½ minutes, dip it in cold water to cool. The skin of properly ripened fruit will then slip readily. For underripe fruit longer immersion may be needed.

### Pretreatment of fruits

Fruit that is sliced or cut is most subject to oxidation or discoloration because the soft tissue is exposed; the oxidation is caused by enzymes and the oxygen of the air. As soon as the fruit is peeled or sliced, the cut surfaces should be temporarily protected. This can be done best by dipping the product in a weak salt solution (approximately 3 tablespoons per quart of water). Best protection against discoloration during the drying process is afforded the product by subjecting the fresh cut fruit to the fumes of burning sulphur. This treatment will also afford protection against insects to the dry fruit in storage. All highly acid fruit that tends to oxidize or discolor readily needs to be sulphured and must not be dried on wire-screen trays. To safeguard the product, use only wood-slat trays.

Sulphuring takes from 30 minutes to 2 hours for most fruit products (see Table 2). Pears, peaches, and apricots can, however, be subjected to these fumes (sulphur dioxide) for as long as 8 hours without injury. Long sulphuring bleaches the color, which will return as the product dries. The sulphur absorbed by the fruit acts

as a preservative, as well as an antioxidant, and is almost completely driven off when the product is cooked.

### Sulphuring of fruits

If the dehydrator is operated on an open porch or in a room where the doors and windows may be conveniently opened, the sulphuring of fruits to be dried may be done in the dehydrator cabinet. The cabinet should be warmed up in the usual manner while the fruit is being prepared. Then the fruit should be placed on the trays and the trays shoved into position in the cabinet. The fan and heating element should then be removed and a pot of burning sulphur set on the cabinet floor beneath the trays for the recommended length of time. The doors and ventilators should then be closed. A piece of paper or cardboard can be used to prevent the escape of the sulphur fumes through the holes drilled in the ventilator doors.

It is always necessary to remove the fan and heating unit before sulphuring as the strong concentration of fumes inside the cabinet is harmful to the metal parts and rubber insulation.

A number two standard fruit can (not enameled) may be used satisfactorily as a sulphur burning pot. About ¾ of an inch of sulphur should be placed in the can and heated on a stove until the sulphur is melted. The melted sulphur can be set aflame with a match or piece of burning paper. Then the can of burning sulphur is set on a brick in the bottom of the dehydrator. If an enameled can is used it should be charged with sulphur and burned outdoors once before using it for sulphur in the dehydrator. All residue remaining in the can after this first burning should be removed, after which the can is ready for use in the dehydrator.

After the sulphuring has continued the recommended length of time, the pot should be removed and set outside the house to finish burning out. The fan and heating unit should then be placed back in the cabinet and the drying procedure carried on as usual. The sulphur fumes will all be expelled from the cabinet by the fan long before the fruit is completely dried.

## PREPARATION OF VEGETABLES FOR DEHYDRATION

In general, the preparation of vegetables for dehydration is not different from their preparation for any other home use. Precautions should be taken to see that the pieces of the prepared product are of uniform thickness as indicated for that product in Table 1.

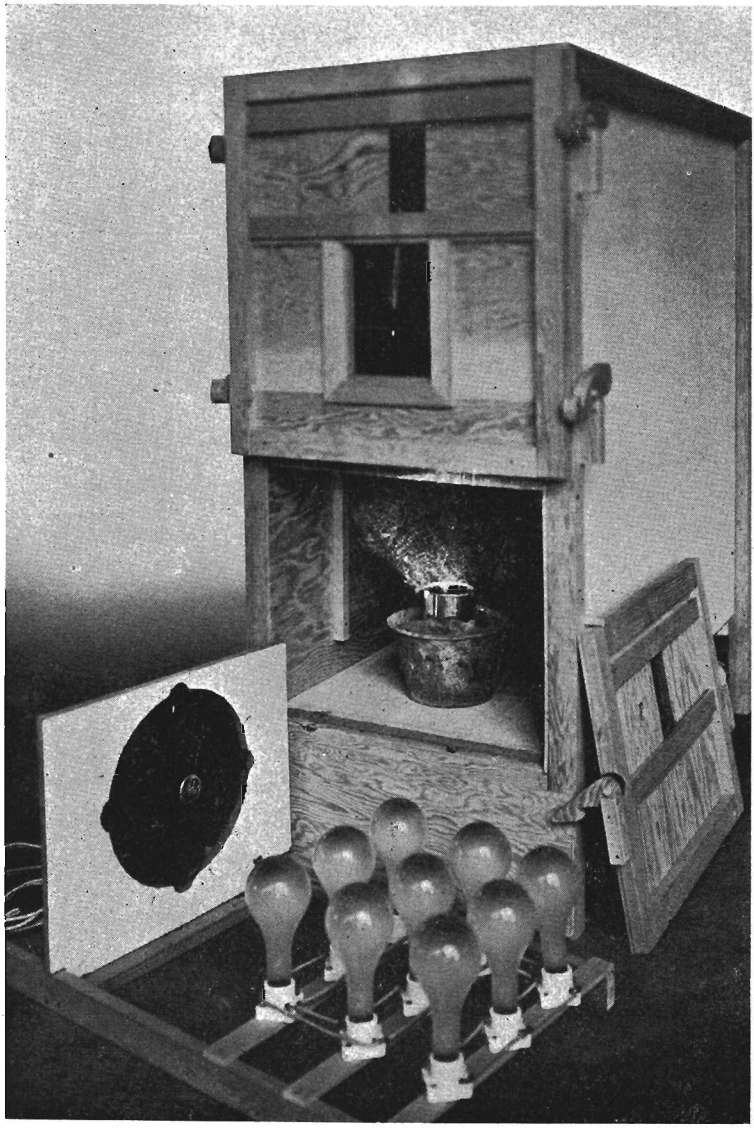

Figure 5. Method of burning sulphur to preserve the color of cut fruits.

## Blanching vegetables

Blanching, or heating with steam or boiling water from 1 to 8 minutes, is the most important step in the preliminary treatment of vegetables. If the products are not thoroughly blanched, they will not retain their flavor, color, or nourishing qualities. All fresh, uncooked vegetables contain quantities of enzymes. These enzymes are complex organic substances that cause changes in living tissue. They are present and active during the life of the vegetable and continue to function in breaking down plant materials unless they are inactivated. Blanching is the most practical process by which we can stop the action of enzymes that produce off flavors and odors during storage and make the dehydrated products undesirable for consumption.

Figure 6. Blanching vegetables by steaming method. Small batches are necessary to insure thorough heat distribution. Note steam escaping because of pressure generated.

The blanching can be accomplished with the use of steam or hot water. Steam is often hard to obtain in quantity. The use of large 4 to 6 gallon cookers or soup stock pots in which a large flat area of water can be heated quickly will materially assist in the formation of steam. Construct or purchase a wire basket that will fit inside the cooker and can be supported above the water. Cover the

bottom of the cooker with about 2 inches of boiling water. Place enough prepared vegetable material to fill one tray only, or not more than 1½ inches of vegetables in the basket at one time. Support the basket on a wire rack in the steam above the boiling water, closing the lid tightly. When a light pressure is formed, indicated by the

Figure 7. Spread blanched vegetables while still hot.

pressure of escaping steam from below the lid, the blanching of the vegetables will proceed quickly. The time of blanching, after the pressure is created, is governed by the product and its compactness. (See Table 3.)

Steam blanching is more conservative of nutrients but will be somewhat slower than hot water blanching because of the lack of distribution of heat through the cold vegetables. Batches of vegetables will blanch more quickly in hot water because of the quicker distribution of heat. For steam blanching not more than 1½ inches of vegetables should be placed in the basket at a time.

When hot water is used as a blanching medium, use a large vessel as indicated under steam blanching. Fill vessel at least half full of water. Place on largest burner to supply heat quickly. Bring water to a vigorous boil. Place enough vegetables for one tray in the wire basket, submerge in boiling water, and agitate by stirring gently or by raising and lowering the basket during blanching. (Refer to Table 3 for exact blanching time.) It must be recognized that large quantities of water drop less in temperature than small quantities when the cold vegetables are introduced; hence, for blanching in hot water use of a large vessel is imperative. Before blanching another basket of vegetables, be sure the water has again come to a vigorous boil.

## PACKING AND STORAGE OF DEHYDRATED PRODUCTS

Keeping quality of dehydrated products is dependent, to a considerable extent, on their final moisture content. The lower the moisture content, the better the keeping quality. After drying, fruits and vegetables will take up moisture from the surrounding air if allowed to remain exposed for any length of time. This absorption takes place rapidly on days when the natural humidity of the air is high. To avoid absorption and to improve keeping quality, store under moisture proof conditions immediately after drying.

The best types of containers for dehydrated products are glass jars with tight seals such as rubber rings or composition gaskets. If the jars have been previously used for coffee or vegetable oils, it is extremely important to clean them well to remove all traces of odor that might contaminate the dehydrated products. Dried vegetables such as carrots are quite susceptible to flavor changes and foreign odors.

Cans with tight seals or heavily waxed fiberboard containers that are moisture proof can likewise be used. It is imperative, however,

that any type of container used must be sealed to prevent air leakage. The addition of the better grades of sealing tape will further prevent the entry of moisture. Air leakage means moisture absorption and the possibility of insect infestation. Before placing the freshly dehydrated products in containers, be sure that the cans, jars, or containers have been thoroughly dried out by heating in an oven. Place the freshly dehydrated product in the hot or still warm container.

Figure 8. Containers that can be used for proper storage of dehydrated vegetables. All these containers can be made airtight.

Fill the containers as full as possible. Use smaller containers to avoid opening and exposing large batches of dehydrated fruits or vegetables.

Large tin cans with airtight covers can be used to store many small vapor-proof cellophane packages. These small packages should contain a complete serving for the family. Use of small packages best preserves the product against breakage and moisture absorption. Removal of a bag for serving is a simple procedure and involves no damage to the rest of the food material stored in the can.

Cool storage is essential for long keeping of packaged dried material.

## PREPARATION OF DEHYDRATED FOODS FOR COOKING

Some dehydrated foods benefit by preliminary soaking, while others, especially the green, leafy vegetables, refresh during cooking. The size of the pieces determines, to a large extent, the length of time for soaking. The larger pieces take up the water more slowly, while the smaller pieces, such as shreds, dices, slices, etc., have more surface per unit volume for absorption of water and refresh more quickly. If a food is left to soak too long, it may become water-logged and produce an unattractive product when cooked. Peaches soaked 24 hours, then cooked, do not have the attractive shape, firmness, or flavor of peaches soaked only 12 hours before cooking.

Fruits can be soaked overnight without spoilage, but dehydrated vegetables, if allowed to soak more than 2 hours, may show evidence of spoilage. To refresh dehydrated carrots or cabbage to be used as a fresh product in preparing salads, soak overnight in a refrigerator or ice box to prevent spoilage.

Foods that have been soaked should be cooked in the water in which they were soaked. Just enough water should be used to allow for refreshing and for cooking. As the majority of vegetables have been precooked or blanched before drying, they will not require as long to cook as fresh vegetables. The cooking required will depend on the stage of maturity at the time the vegetables were dried. When soaking and cooking, use 1½ to 2 measures of water for every measure of dehydrated vegetable with the exception of green, leafy vegetables. Cook all foods until tender. The foods may be soaked in the container in which they are to be cooked. More water can be added before cooking, if needed.

Table 1 gives the amount of water, time of soaking, and time of cooking for some common dehydrated foods. These figures will vary with the style and size of cut and maturity of the product when dehydrated.

The reconstituted or refreshed foods may be used in the same manner as fresh-cooked foods—buttered, creamed, sautéd, pickled, etc. Cabbage and carrots refreshed overnight in a refrigerator or ice box without cooking can be used in salads.

Onions to be used as flavoring may be powdered and a bit of powder added as seasoning to foods without refreshing. If onion slices are wanted, the slices should be soaked for 15 minutes in water, then simmered gently for 20 to 30 minutes. One tablespoon of onions will need 3 tablespoons of water for refreshing.

Dehydrated foods that have been properly prepared make attractive and flavorful dishes on reconstitution.

Table 1. Approximate Amounts of Water Necessary for Refreshing Fruits and Vegetables

| Product | Weight per cup | Reconstitution proportions | | Time of soaking | Time of cooking |
|---|---|---|---|---|---|
| | | Volume of dehydrated product | Volume of water | | |
| *Fruits* | *Ounces* | *Cups* | *Cups* | | *Minutes* |
| Apples | 2.3 | 1 | 1 | 1 hr. | 10 |
| Apricots (packed) | 7.0 | 1 | 1½ | 8–12 hr. | 15 |
| Cherries | 7.0 | 1 | 2 | 8–12 hr. | 20–30 |
| Cranberries | 2.0 | 1 | 1 | 5–6 hr. | Till tender |
| Peaches | 3.0 | 1 | 1½ | 8–12 hr. | 15 |
| Pears | 2.4 | 1 | 1½ | 8–12 hr. | 15 |
| Prunes | 5.5 | 1 | 1 | 8–12 hr. | 15 |
| Raspberries | 2.0 | 1 | 1½ | 8–12 hr. | 10 |
| Rhubarb | 1.3 | 1 | 1½ | 30 min. | 15 |
| Strawberries | 2.5 | 1 | 2 | 8–12 hr. | 10 |
| *Vegetables* | | | | | |
| Asparagus | 2.0 | 1 | 1¼ | 30 min. | 15 |
| Beans (snap or green) | 2.2 | 1 | 2 | 30 min. | 20 |
| Beans (Lima) | 4.1 | 1 | 2½ | 30 min. | 15 |
| Beets (shredded) | 1.5 | 1 | 2 | 30 min. | 10 |
| Broccoli | 0.5 | 1 | 1 | 30 min. | 5 |
| Cabbage (shredded) | 0.7 | 1 | 1½ | none | 10 |
| Cabbage (red) | 0.7 | 1 | 1½ | none | 10 |
| Carrots (shredded) | 1.0 | 1 | 1½ | 30 min. | 10 |
| Celery | 0.7 | 1 | 2½ | 30 min. | 30 |
| Corn | 5.5 | 1 | 2½ | 30 min. | 15 |
| Parsnips | 1.8 | 1 | 2 | 30 min. | 15 |
| Peas | 4.0 | 1 | 2½ | 30 min. | 10 |
| Peppers | 0.1 | 1 Tblspn. | 2 Tblspn. | 30 min. | 10 |
| Potatoes (Irish) (Julianne) | 1.8 | 1 | 2 | 30 min. | 20 |
| Potatoes (Sweet) | 4.3 | 1 | 1½ | 30 min. | 30 |
| Pumpkin (shredded) | 1.0 | 1 | 1 | 30 min. | 10 |
| Pumpkin (ground fine) | 2.0 | ½ | ⅝ | none | 20 |
| Rutabagas | 2.0 | 1 | 2½ | 30 min. | 10 |
| Spinach | 0.5 | 1 | ⅝ | none | 10 |
| Squash | 1.0 | 1 | 1 | 30 min. | 10 |
| Swiss chard | 0.5 | 1 | ⅝ | none | 10 |
| Tomatoes | 1.8 | 1 | 1½ | none | 15 |
| Turnip | 2.0 | 1 | 2½ | 20 min. | 10 |

Table 2. Directions for Preparing and Dehydrating Fruit*

| Product | Stage of maturity | Preparation | Treatment before dehydration | | Spread per square foot of tray surface | Approximate yield from 100 pounds of fresh material | | Dehydration temperature | Approximate drying time | Dehydrated product | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Method | Time | | Prepared | Dehydrated | | | Condition when dry | Keeping quality |
| | | | | | *Pounds* | *Pounds* | *Pounds* | | *Hours* | | |
| Apples | Firm ripe | Peel, core, slice, or cut in eighths; light brine dip protects color of fruit while handling | Sulphur | 1–1½ hours | 1¾ | 60 | 10 | 150°–155° | 6–8 | Springy | Good |
| Apricots | Firm ripe | Cut in halves; remove pit | Sulphur | 1–1½ hours | 1¾ | 90 | 18 | 150°–155° | 12–18 | Leathery | Good |
| Berries | Firm ripe | Carefully spread on trays to prevent bleeding | None | None | 1 | 100 | 15–18 | 150°–155° | 10–15 | Springy | Good |
| Sweet and sour pitted cherries | Well ripened | Pitted sweet or sour cherries dry quicker than unpitted. Spread carefully on tray | Sulphur | ½ hour | 1¾ | Pitted 78–80 | Pitted 26–30 | 150°–155° | 8–12 | Leathery | Good |
| Unpitted | | | | | | Unpitted 97–98 | Unpitted 28–30 | | | | |
| Cranberries | Full ripe | Whole or chopped; chopped dry best | None | None | 1½ | 100 | 10–14 | 150°–155° | 4–8 | Brittle | Good |
| Peaches | Full ripe | Cut in halves; remove pits | Sulphur | 1–1½ hours | 1¾ | 85–90 | 15–20 | 150°–155° | 15–20 | Leathery | Good |
| Pears | Firm ripe | Cut in halves; core | Sulphur | 1½ hours | 1¾ | 80–85 | 17–20 | 150°–155° | 15–20 | Leathery | Good |
| Prunes | Full ripe | Whole or halved prunes can be dried. Pitted fruit dries more rapidly | None, although a light sulphuring can be used | ½ hour | 1¾ | 100 | 33–35 | 150°–155° | 15–24 | Pliable | Good |
| Rhubarb | Mature | Trim, wash, cut in slices ½ inch thick | Steam | 2–4 minutes | 1½ | 55–60 | 6–9 | 150°–155° | 10–15 | Tough | Good |

* Wherever possible, freeze or can fruits.

Table 3. Directions for Preparing and Dehydrating Vegetables*

| Product | Stage of maturity | Preparation | Treatment before dehydration | | Spread per square foot of tray surface | Approximate yield from 100 pounds of fresh material | | Dehydration temperature | Approximate drying time | Dehydrated product | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Method | Time | | Prepared | Dehydrated | | | Condition when dry | Keeping quality |
| | | | | *Minutes* | *Pounds* | *Pounds* | *Pounds* | | *Hours* | | |
| Asparagus | Tender tips; stalks soft not woody | Wash, trim, cut into 1½" lengths; split large pieces | Steam blanch | 4 | ¾ | 65–75 | 6–8 | 150°–155° | 7–9 | Brittle Greenish-black | Good |
| Beans (green) | Mature, tender, not stringy | Snip, cut into 1-inch lengths | Steam blanch | 10–12 | ¾ | 90 | 9–12 | 150°–155° | 8–12 | Brittle Greenish-black | Good |
| Beans (Lima) | Tender, immature | Shell, wash | Steam or boiling water blanch | 5–6 | ¾ | 30–35 | 15–18 | 150°–155° | 8–10 | Hard Wrinkled | Good |
| †Beets | Good for table use | Wash, trim and cook for 15 min., peel, slice or strip ⅛ inch thick | Steam blanch | 5–6 | ¾ | 75–80 | 8–12 | 150°–155° | 8–10 | Brittle | Good |
| Broccoli | Good and succulent | Trim, wash, and slice lengthwise | Steam blanch | 4–5 | ¾ | 80 | 10–12 | 150°–155° | 8–10 | Brittle | Good |
| †Cabbage | Good and succulent | Trim, core, and wash. Cut in ⅛ inch shreds | Steam blanch | 4–5 | ¾ | 85 | 6–9 | 150°–155° | 10–12 | Brittle | Good |
| †Carrots | Medium sized, succulent | Wash, peel, trim. Cut in slices or strips | Steam blanch | 5–6 | ¾ | 80–85 | 8–9 | 150°–155° | 7–8 | Brittle | Fair |
| Celery | Medium sized, succulent | Wash, cut stalks into thin slices. Dry leaves separately for soup | Steam blanch | 2–3 | ¾ | 100 | 12–14 | 150°–155° | 8–10 | Brittle | Good |
| Corn | Milk stage | Husk, wash, cut from cob after blanching | Boiling water | 8–10 | 1 | 35–40 | 8–10 | 150°–155° | 8–10 | Brittle | Good |

* Wherever possible, freeze or can vegetables.
† Store for use during fall or early winter. Spoilage will be reduced and quality retained if these vegetables are dried for use in late winter and spring months.

Table 3. DIRECTIONS FOR PREPARING AND DEHYDRATING VEGETABLES*—*Continued*

| Product | Stage of maturity | Preparation | Treatment before dehydration | | Spread per square foot of tray surface | Approximate yield from 100 pounds of fresh material | | Dehydration temperature | Approximate drying time | Dehydrated product | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Method | Time | | Prepared | Dehydrated | | | Condition when dry | Keeping quality |
| | | | | *Minutes* | *Pounds* | *Pounds* | *Pounds* | | *Hours* | | |
| †Onions | Mature succulent | Trim, remove outer leaves, wash, slice ⅛ inch thick | None | None | ¾ | 88–90 | 8–9 | 150°–155° | 10–12 | Brittle | Good |
| †Parsnips | Mature, tender not woody | Wash, peel, trim. Cut in ⅛ inch slices or shreds | Steam blanch | 6–8 | ¾ | 77–82 | 12–16 | 150°–155° | 8–9 | Brittle | Good |
| Peas (Sugar) | Full grown but not hard or over-ripe | Pod and wash | Steam blanch | 2–3 | 1 | 55–60 | 18–23 | 150°–155° | 7–8 | Hard Wrinkled Brittle | Good |
| †Potatoes | Proper condition for table use | Peel, trim, wash, cut into shreds, ¼ inch slices or strips | Steam blanch | 5–7 | 1 | 72–76 | 10–12 | 150°–155° | 5–7 | Hard Brittle | Good |
| †Pumpkin | Good table condition | Peel, seed, wash and shred | Steam blanch | 3–4 | ¾ | 70–72 | 7–12 | 150°–155° | 10–14 | Tough Brittle | Good |
| Spinach or Greens | Good table condition | Cut off roots ; wash and sort | Steam or water blanch | 1–2 | ½ | 60–75 | 8–10 | 150°–155° | 7–9 | Crisp Brittle | Good |
| Sweet Potatoes | Good table condition | Trim, peel, wash ; slice in ¼ inch slices or strips | Steam blanch | 2–3 | 1 | 80–85 | 26–28 | 150°–155° | 10–14 | Hard Brittle | Good |
| Tomatoes | Good, firm table type only | Light blanch, peel, core ; cut into ⅜ inch slices | Steam blanch | 2–3 | ¾ | 88–92 | 4–5 | 150°–155° | 15–18 | Tough Brittle | Good |
| †Turnips or Rutabagas | Good table condition | Trim, peel, wash, slice, strip, or shred | Steam blanch | 3–4 | ¾ | 81–85 | 8–10 | 150°–155° | 15–18 | Tough Brittle | Good |

* Wherever possible, freeze or can vegetables.
† Store for use during fall or early winter. Spoilage will be reduced and quality retained if these vegetables are dried for use in late winter and spring months.

# FULL-SIZE PATTERNS FOR DOOR LATCHES