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OREGON'S FOOD DEHYDRATION PROGRAM

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In past years Oregon was well equipped with drying equipment for handling the available fruit crops, but years of low prices have gradually reduced interest in crops requiring drying as a means of preservation. In the early twenties quite a large number of modern dehydrators were built. Some of the old or tunnel driers were converted into modern units by installation of fans. After a few years, however, the market situation changed so definitely that driers were neglected and finally many were torn down

In an effort to determine what facilities there are still available to dehydrate the fruit and vegetable crops of Oregon this survey was made.

Available Types of Driers

Originally the kiln and stack type drier predominated in Oregon. Gradually through active participation by research workers of the Oregon Agricultural Experiment Station and others in the problems of drying, the Oregon tunnel drier became the type most generally used.

In 1919 investigations in this field of work brought out the importance of mechanical recirculation of air. This resulted in the adaptation of fans and recirculation to the old tunnel driers and development of new modern dehydrators along similar lines. These newer types are now available for the drying of fruits and vegetables.

Adaptability of Dehydration Plants to the War Effort

Reduction of bulk and weight, which contribute to the ease of packing and shipping, are factors that should be considered important in food preservation for the armed forces. By dehydrating vegetables and fruits we reduce their bulk and weight by removing water. The material decrease in weight varies between 70 and 90 percent of the original weight of the product. This latter characteristic is important from a shipping standpoint. With every shipping facility taxed to its utmost capacity, dehydrated products representing large amounts of food with a minimum of bulk, can be shipped to make available a greater variety of food for army, navy, and lend-lease.

Oregon's dehydrating plants, originally designed to meet the needs of the fruit grower, are readily adaptable for drying other products. Most of the better class dehydrating plants have capacities averaging from 9 to 18 tons of potatoes per day. It is obvious to those acquainted with this industry that drying equipment alone will not be sufficient to adapt the dehydrator to this type of food preservation. When products like potatoes, cabbage, onions, beans, etc., are to be handled, preparation machinery such as blanchers, peelers, slicers, and shredders will be needed. As most canning machinery manufacturers have converted their operations to defense with only a limited amount of equipment being manufactured for the canning and drying industry it can readily be seen that a cooperative arrangement of dehydration plants with long established canneries would be the important approach to the problem of utilization of our dehydration facilities.

In most of our fruit-producing areas where dehydrators were originally set up, canneries likewise exist. It is therefore conceivable that organization of dehydrators and canneries into units where one could serve the other would be possible. This would then make the preparation machinery of the canneries available to the dehydration plants.

When most of these dehydrators were built, the type of heating plant installed was a direct-heat unit fired by oil. Such a unit ordinarily would not have sufficient capacity to provide the necessary steam so essential for the blanching of vegetables. Conversion of these plants to vegetable drying would require the addition of a boiler in each case to provide sufficient steam for blanching and cleaning. In most dehydration plants ranging in size from 9 to 30 ton capacity, a boiler of 30 to 40 H.P. would be necessary.

Utilization of Natural Draft Driers

Because of their limited capacity and control, the many natural draft driers in the state are not so well adapted to commercial drying of vegetables. For community and farm use in the conservation of fruit and vegetables, however, they are quite suitable. To make them available for this purpose, families should organize in the neighborhood of one of these units and set up facilities to care for blanching and the continuous operation of the drying unit during the harvesting period. This method of drying would be more efficient and would conserve a large quantity of food material for the civilian population during this emergency.

Approximate State Drying Capacity

In the survey of drying plants which we have just completed, we have compiled the total tonnage for each type of drying unit. The following figures will indicate approximately how many plants of each group there are still available. The capacities of these plants are calculated on actual fill of raw materials. If the drying time is 24 hours the total volume of the dehydrators would be 762.51 tons per day. The remodeled Oregon tunnel type driers with fans would have a daily capacity of 683.75 tons. The natural draft driers and stack type drying units would have a total drying capacity of 365.81 tons of fresh material per day. The drying rate of the natural draft driers would be just half that of

the dehydrators. The total state capacity therefore of all drying units here recorded would be 1812.07 tons per day.

Considerable discussion has arisen regarding the possible production capactiy of all the drying units in the state under our present emergency. If we assume that these plants will be used for drying prunes the following will be a fairly true situation.

It is usually considered that twenty days is the average drying time for the prune crop; therefore, 1812.07 x 20 days equals 36,241.40 tons or 72,482,800 pounds approximate capacity of our drying units.

Present Facilities Inadequate for Prune Crop

Present facilities are adequate to take care of our prune crop if it is abnormally low or the canneries take a large quantity of the available supply of fresh prunes. It must be remembered, however, that the drying plants here indicated are not all well located with reference to the larger prune plantings and therefore the production would hardly be expected to be as high as our calculations show. We feel that our drier capacity is very inadequate to handle our prune crop unless canners will be permitted to pack more fruit than is indicated by the War Production Board's figures.

Planning the Dehydration Program

According to the 1941 statistical survey the total vegetable crop of Oregon for 1939 was 338,683 tons. Thus if the total crop were dehydrated the total amount of the dried material would be 49,679.11 tons. According to these figures the total output of vegetables in the state of Oregon could be dehydrated in a period of 20 days, indicating the desirability for increased tonnage in this field. The following tabulation indicates the tonnage of the various crops on both the fresh and dry basis.

Production of Vegetable Crops in Oregon
for processing and market

1939 Production*

	Fresh basis	Converted to dry basis
Beets	3,200 tons	266.66 tons
Cabbage	13,200 "	694.76 "
Carrots	7,500 "	846.66 "
Celery	12,150 "	714.70 "
Peas	18,952 "	3,790.40 "
Onions	44,550 "	5,568.75 "
Potatoes	216,000 "	36,000.00 "
Beans (Green)	9,400 "	940.00 "
Sweet Corn	3,900 "	390.00 "
Tomatoes	9,831 "	467.18 "
TOTAL	338,683 tons	49,679.11 tons

Under the present war emergency, considerable emphasis is being placed on dehydration. Whether a packer should undertake to dry vegetables under this program is predicated on:

First, the number of dehydrating plants available in the immediate vicinity.

Second, the assurance of sufficient capital to operate the plants successfully.

Third, a definite assurance of contracts for dried materials that would keep the plant operating almost continuously.

Fourth, grouping cooperative dehydrating units with capacities to assure a production of at least 500,000 pounds of dried vegetables a year.

Fifth, the opportunity to cooperate with canneries nearby so that preparation machinery could be obtained during the operating period.

Sixth, plans which assure a plentiful supply of steam for blanching and cleaning.

To plan such a program some facts are necessary so that capacities and costs can be studied. Essential in this connection are the drying ratios, approximate rate of drying and spread per square foot of tray surface. The following table will give some facts for the most important fruits and vegetables.

Product	Percent Water	Preparation Waste	Tray Spread Per Sq. Ft.	Approximate Drying Time	Approximate Drying Ratio
Apples	84.1	40 - 45	1.5#	8-10 hrs	6-1
Apricots	85.4	10 - 15	2.0#	12-18 hrs	5-1
Blackberries	85.3	None	1.2#	10-15 hrs	4-1
Cherries (sweet pitted)	83.0	15 - 19	1.0#	12-15 hrs	3-1
Loganberries	82.9	None	1.2#	10-15 hrs	4-1
Peaches	86.9	15 - 17	2.5#	18-24 hrs	5-1
Pears	82.7	5 - 10	2.5#	18-24 hrs	5-1
Prunes	75.0	None	3.0#	24-26 hrs	3-1
Raspberries (black)	80.7	None	1.0#	10-15 hrs	4-1
Rhubarb	94.9	40 - 45	1.0#	10-15 hrs	10-1
Strawberries	90.0	5 - 10	1.2#	10-15 hrs	8-1
Beans (green)	88.9	8 - 12	.8#	8-12 hrs	10-1
Cabbage	92.4	15 - 20	1.0#	8-10 hrs	19-1
Carrots	88.2	18 - 23	1.5#	8-12 hrs	9-1
Celery	97.3	18 - 23	1.0#	8-10 hrs	17-1
Corn	73.9	60 - 65	1.7#	5-10 hrs	10-1
Onions	87.5	8 - 12	1.2#	5-10 hrs	8-1
Parsnips	78.6	18 - 23	1.2#	8-12 hrs	5-1
Peas	74.3	40 - 45	1.0#	8-12 hrs	5-1
Potatoes	77.8	18 - 23	1.2#	8-12 hrs	6-1

(continued)

Product	Percent Water	Preparation Waste	Tray Spread Per Sq. Ft.	Approximate Drying Time	Approximate Drying Ratio
Pumpkin	90.5	25 - 30	1.5#	12-16 hrs	11-1
Squash	90.4	25 - 30	1.5#	14-18 hrs	9-1
Spinach	92.7	45 - 55	.5#	6-10 hrs	16-1
Sweet Potatoes	68.5	20 - 25	1.5#	5-10 hrs	4-1
Tomatoes	94.1	15 - 30	1.2#	10-14 hrs	21-1
Turnips	90.9	20 - 25	1.2#	8-12 hrs	10-1

Determining Dehydrator Capacity

To determine the capacity of any dehydrating plant the following simple calculations will give the necessary information.

Total up the filling capacity of the unit by trays. Example--If the plant has 6 tunnels 40 feet long and holds ten cars per tunnel and each car holds 18 trays the calculation is as follows:

10 cars x 6 = 60 cars per filling
60 cars x 18 trays = 1080 trays

Assuming that the product to be dried would weigh 1.2 pounds per square foot of tray spread and the tray was 3' x 3' square

3' x 3' = 9 sq. ft. of tray surface
9 x 1.2 = 10.8 lbs. per tray
1080 trays x 10.8 lb. = 11,664.0 lbs. per filling

The dehydration plant would be in continuous operation. The tunnels are of the progressive type. (This means the raw prepared product goes in one end and comes out dry at the other.) As the drying time is 8 hours, the tunnels could be filled 3 times which would give the daily capacity of the plant.

11,664.0 lbs. x 3 = 34,992.0# or 17.496 tons of raw material per 24-hour day

If the drying ratio then is assumed to be 4-1 the tonnage of dry product for this plant in 24 hours would be

17.496 ÷ 4 = 4.374 tons dried product

From the above calculations a definite production basis can be established with plants under consideration for dehydrating. The tabulated information given above is sufficiently accurate to use for all preliminary estimates.

Preparation Methods Important

In any drying operation the preliminary preparation and pretreatment given the product is the first essential step in obtaining good quality. Without sufficient consideration being given to this step in the manufacturing procedure, the resulting product will not be of good quality and will ultimately reflect on future business. As it is the desire of most manufacturers who are now dehydrating vegetables to later develop a domestic trade for their products, close attention will have to be given to the details that have a bearing on palatability and nutritive characteristics.

As in freezing vegetables preliminary handling is as important as the final manufacturing procedure.

From years of work on this problem with students, we have been able to demonstrate quite conclusively that certain preparations must be made with each vegetable. Briefly, therefore, we are outlining some of the steps necessary for the preparation and drying of fruits and vegetables.

Apples

This fruit requires peeling, coring, and trimming which removes from 35 to 40 percent of its initial weight. If good-sized apples are used the waste becomes less.

Oxidation usually sets in quite rapidly and in order to stop this to some extent the fruit can be dropped in a light brine or water after peeling and coring and before slicing. In slicing, a cut of $\frac{1}{4}$ inch thick makes a suitable ring. Dicing is often resorted to by some operators. Immediately after slicing the fruit is trayed preferably on wood slat trays. Then the fruit is spread thin enough to give about 1.5 pounds per square foot, stacked on cars and sulphured for $1\frac{1}{2}$ to 2 hours. The drying is then carried out at temperatures ranging from 130° to 155° F. and with a finishing relative humidity of not over 15 percent. The drying time under recirculatory system will be from 8 to 10 hours. Final moisture content approximates 15 percent with a maximum of 22 percent for shipping.

Apricots

This product is not grown in abundance in Oregon, but our fruit is quite well suited to dehydrating. Preparation is simple. The fruit is split in two, pitted, placed on wood slat trays and sulphured, keeping the pit pocket up to avoid loss of liquid formed in sulphuring. The fruit is sulphured for at least one-half to 1.5 hours. The longer sulphuring period has its advantages in the case of large fruit. The drying is then carried out at temperatures ranging from 135° to 155° F. with relative humidities not exceeding 15 percent. The drying time varies between 10 and 18 hours depending on the drying unit. Final moisture content is 15-16 percent.

Berries

Berries require no pretreatment. If dirty, they should be washed previous to spreading on trays. Excessive handling, however, causes bleeding with considerable loss. They are spread on trays in the ratio of 1 to 1.2 pounds per square foot, and placed in the dehydrator at a temperature of 130° F. and 40-45 percent relative humidity. The drying is finished at 150° F. with 15 percent relative humidity. Finishing moisture should not exceed 15 percent. Drying time is usually 8-12 hours.

Cherries

Like berries this fruit requires no pretreatment. The Royal Ann cherry can be sulphured, but seldom is. The fruit can be dried with or without stems or pits. If not stemmed, the removal of these should take place as soon as the fruit is removed from the dehydrator, because at that time there is no great tendency for the stem to stick.

Drying should take place at temperatures ranging from 130-155° F. with a finishing relative humidity of 15 percent. The drying time varies from 12-15 hours depending on drying conditions.

When ready for packing, this fruit is best steam-blanched before boxing.

Cranberries

This fruit is easily handled because it requires so little preliminary attention. Sorting is essential to eliminate partially decayed berries. After sorting, the berries are washed by running through cold or warm water and spread on trays in the ratio of .8 to 1 pound per square foot. This product may be chopped before traying. The dehydration is carried out at temperatures ranging from 135° to 150° F. with a finishing relative humidity of 15 percent. The drying time for this product ranges from 5-8 hours.

Peaches

It has been quite a common custom to dry this fruit in California but seldom in Oregon. Peaches must be pitted before drying. The fruit is treated with sulphur fumes as indicated under apricots, and dehydrated at a temperature ranging from 130° to 155° F. Drying times vary from 18-22 hours depending on the fruit and type of dehydrator. Finishing moisture should range between 15-18 percent.

Pears

Pears must be exceptionally ripe for drying. Prehandling this fruit means storage under proper temperatures, 65° to 68° F., with about 80 percent relative humidity. After the fruit is thoroughly ripe it is cut in half, spread on trays, and sulphured for 30 minutes to 1½ hours. Short sulphuring produces a white product and long sulphuring makes a translucent product. The latter type is more common, but the former has a decided pear characteristic.

This fruit is dried at temperatures ranging from 135° to 155° F. in a progressive-type recirculated-air dehydrator. Relative humidity should not exceed 15 percent at the hot end of the drying tunnel.

Prunes

Italian and Petite prunes require no preliminary treatment except thorough washing and sorting before drying. Care should be exercised to see that all brown rot, decayed, or seriously damaged fruit is removed before traying. The spread is approximately 3 pounds per square foot. Drying temperatures range from 140° to 165° F. with relative humidities of 15-18 percent for normal drying operation. The drying ratios are 3-1 for Italian prunes and $2\frac{1}{2}$-1 for Petite prunes. Final moisture should approximate 18-20 percent.

Vegetable Dehydration

To insure preservation of quality the most essential procedure in handling vegetables for dehydrating is blanching. During World War I many tons of dried vegetables were discarded due to spoilage in storage because of improper treatment. Inactivation of the enzymes responsible for spoilage is the most important step toward the preservation of quality in any vegetable product. When blanching vegetables the temperature in the center of the product must reach at least 165°-170° F. to assure enzyme destruction. So often this operation is done superficially and the products later spoil. The first consideration therefore should be to see that steam is applied for a sufficient time to insure thorough penetration of heat and to raise the temperature high enough to stop any further chemical changes.

Beans (Green)

This product should be snipped, cut, or sliced, blanched in steam at 200° F. for 15 to 20 minutes or higher temperatures for a shorter time. After blanching, the beans are spread on trays at the rate of .8 pound per square foot and placed in dehydrator at 135° F. The finishing temperature should not exceed 155° F. Humidity for drying vegetables should not exceed 15 percent at the hot end of the drying unit. Lower humidities (12 percent) are acceptable. Drying time for this product varies between 6-10 hours, depending on the unit. The finished dried product should have a moisture content of 5 percent.

Cabbage

When handling cabbage, be sure that trimming is done carefully enough to remove all brown or discolored parts. If the outer green leaves are tender and of good quality do not remove them as they contain the largest amount of vitamin substance. The hard core is removed before allowing the head to go to the slicer, washed thoroughly, sliced, using standard cabbage cutter, and spread on trays at rate of one pound per square foot. Steam blanch is maintained for at least 10-15 minutes at 200° to 212° F. and the drying temperatures should range from 135° to 150° F. with relative humidity of 12 percent at the hot end of the drying tunnel. Final moisture content should not exceed 5-6 percent.

Carrots

While this product can be stored in the fresh state in many sections, its condition for the Army and Navy must be in the dried form. Carrots should be washed, peeled, and trimmed. Usually an abrasive peeler is used to speed up the work. Finally they should be sliced, diced or shredded. Blanching is essential and takes from 5-10 minutes at 200° to 212° F. depending upon the size of the material. After blanching, the carrots are placed on trays in the ratio of 1.5 pounds per square foot and dried at 135° to 150° F. Final moisture content should be approximately 5-6 percent.

Celery

This product can be dried in two forms, i.e., the leaves, which are used mostly as flavoring for soups and cooked meats and the stalks for a vegetable. The browned leaves are trimmed off, coarse material is rejected, and the leaves are separated from the stalks. After careful washing the leaves are blanched for 1-3 minutes at 200° to 212° F. The material should be spread on trays, leaves .5 pound per square foot, stalks 1 pound per square foot, and dried at temperatures of 135° to 150° F. Final moisture content should not exceed 5-6 percent.

Corn

Probably one of the best dried vegetables is sweet corn. Good succulent ears are preferred. After husking and washing the ears, they are blanched in live steam for 8-10 minutes at 212° F., cut from cob and spread on trays at rate of 1.7 pounds per square foot. The drying is carried out at a temperature of 135° to 165° F. Final moisture content should be 5-6 percent.

Onions

Handling onions is not difficult but care should be taken to see that discolored parts are removed in trimming. It is customary to either slice or shred this vegetable and steam blanch for $1\frac{1}{2}$ to 2 minutes on trays maintaining a temperature of 200° to 212° F. for best results. Tray spread equals about 1.2 pounds per square foot. Dry to a final moisture content of 5-6 percent with a dehydrator temperature ranging from 135° to 150° F. for best results.

Peas

Shell, clean and grade peas before blanching. All deformed or off grades should be removed. Extremely small sizes should be sifted out preferably after drying. This will make for greater uniformity. Blanching should be for 2-3 minutes at 200° to 212° F. for best results. Use of steam blanch is preferable as this saves considerable food material which might be wasted in leaching. After blanching, this product is dehydrated at temperatures ranging from 135° to 150° F., utilizing a spread of peas at approximately 1.2 pounds per square foot of tray surface. The final moisture content should be 5-6 percent. Humidities for drying should be kept down to 12 percent.

Potatoes

This product is one of the most commonly used for drying. Washing, peeling and trimming constitute the major preparation procedures. It is, however, necessary to work fast and keep the product from direct contact with the air to prevent discoloration. Slicing, cubing, shredding, and ricing are the common forms of dried product.

To stop discoloration the potatoes should be placed in steam box or blancher at temperature of 212° F. A blanch of 5 minutes will produce a very satisfactory color and a high refreshing characteristic. After blanching, the product is dehydrated at 135° to 155° F. Drying time of this product is variable due to the types of products produced, but usually takes from 8-12 hours. Final moisture should not exceed 6 percent.

Pumpkin and Squash

These two products are handled in the same manner. First, the vegetable is washed, cut open and seeded. The flesh is cut from the skin, shredded and blanched in steam at temperatures of 200° to 212° F. for a period of 5-7 minutes. Steam temperature should be observed carefully to prevent mushing of the product. After blanching, the product is dried at temperatures ranging from 140° to 155° F. with relative humidities of 12-15 percent. Tray spread should not exceed 1.5 pounds per square foot if drying is to take place evenly. Dry to a final moisture content of 5-6 percent. If the product is powdered it should not contain over 3-5 percent moisture for best results.

Spinach and Greens

Most leafy vegetables dry easily but have to be handled carefully to retain their nutritive substances. Usually they contain sand and grit so extensive washing should be practiced. After a thorough trimming and washing, the blanching is conducted for ½ to 1 minute at 200° to 212° F. or 2-3 minutes at lower temperatures. The material should be spread thinly on trays not over .5 pound per square foot of surface and dried at 135° to 150° F. to a final moisture content of 5-6 percent.

Sweet Potatoes

This vegetable should be trimmed and washed carefully, peeled and sliced directly into trays. It is then blanched in steam for 6-8 minutes at 200° F. and dried to a final moisture content of 5-6 percent. Temperature for drying should be from 140° to 160° F. with a relative humidity of 12-15 percent.

Tomatoes

This product is not often dried, but can be made into a very good product. Wash, peel, and trim before final blanching. As there is so much danger of food loss due to the succulence of the product, steaming before drying should be carefully done. Steam should be applied at 200° F. for a period of at least 3 minutes and the drying completed at 135° to 150° F. For tomato juice or pulp the dried product should be quite dry so pulverizing can be done. Moisture content should be 3-5 percent or lower for this purpose.

Packing Dehydrated Products

The problems of handling dehydrated vegetables are not confined to actual drying operations. As packaging and storing is a very important part of the work, close attention should be given to the details which involve keeping the material dry and free from insect contamination.

It is customary to pack dehydrated products in five-gallon square slip-top tin cans. These can be filled easily and the air exhausted for better keeping. To insure improved qualities, the can should be packed with the dehydrated product and the air displaced with carbon dioxide and sealed. This procedure will prevent oxidation and this gas discourages development of insect life. It is important, however, to see that packing occurs soon after the dried vegetables come from the dehydrator.

For packing fruit, wood boxes lined with moisture-proof paper can be used. First, the fruit is steamed to sterilize and equalize it. The temperatures of the fruit should reach 170° to 175° F. After steaming, the fruit is placed in boxes and pressed down firmly. Where products of this kind are packed in tin cans, they should be steamed thoroughly, sealed and sterilized lightly for best results. This applies only to products which have not been sulphured as sulphur attacks the metal cans. Usually prunes, cherries, and some berries can be packed in this manner.

Use of enamel-lined cans for dehydrated products is quite a possibility in order to conserve tin. Metal containers are much superior for keeping dehydrated products moisture-free, air-proof, gas-proof (noxious gases), odorless, tasteless, insect-proof, noncorrosive, hold vacuum and be sufficiently durable to stand up under the rigid shipping conditions the product might be subjected to. For shipment to distant points, enamel-coated steel cans would probably be as effective as tin-coated steel for this purpose.

For short-time handling and domestic trade, bags and cartons with moisture-proof liners will probably be found suitable. Plastic materials offer possibilities for tight containers which might be gas-filled to make them insect-proof and keep the dehydrated product from oxidizing. Moisture resistance is one of the first essentials of any package with next consideration given to tightness to prevent insect infestation and gas tightness to prevent oxidation. Containers of this type are being developed from cellophane and laminated kraft paper with metal ends. These are considered almost equal to tin cans.

Compressed Dehydrated Products

A satisfactory method of packaging dehydrated products is in the compressed form. This method of handling minimizes possibilities of oxidation by reducing surface exposure. Loosely-packed products tend to oxidize because of the large surface exposure.

Compressed food products have many distinctive characteristics. They occupy a small space. They are easy to handle and ship and are space-saving because they concentrate the food in small packages.

*PRETREATMENT AND PRETREATMENT TABULATION OF DEHYDRATION PROCEDURE

FRUITS

Product	Preparation	Waste %	Form for Drying	Tray Load	Pretreatment Type	Pretreatment Time	Drying Temp.[1] Max.	Drying Temp.[1] Min.	Humidity[2] Max.	Humidity[2] Min.	Drying Time	Final Moisture Content
Apples	Peeling Coring Trimming	35-40	Sliced Diced	1.5	Sulfuring	1½-2 hr	155°	135° F	40	15	8-10 hr	15%
Apricots	Halving Pitting	15	Halves	2.0	Sulfuring	½-1½ hr	155°	135° F	40	15	10-18 hr	15-16%
Berries	Washing	1	Whole	1.0	None	None	150°	130° F	40	15	8-12 hr	15-18%
Cherries	Washing Stemming	3	Whole	1.0	None	None	155°	135° F	40	15	12-15 hr	15-18%
Cranberries	Sorting	1	Chopped	.8	None	None	150°	135° F	40	15	5-8 hr	6-8%
Peaches	Halve, Pit	15	Halves	2.5	Sulfuring	½-1½ hr	155°	135° F	40	15	18-22 hr	15-18%
Pears	Ripen Halve, Core	10	Halves	2.5	Sulfuring	½-1½ hr	155°	135° F	40	15	18-22 hr	15%
Prunes	Sort, Wash	1	Whole	3.0	None	None	165°	145° F	45	18	24-26 hr	18-20%

VEGETABLES

					205°-212° F							
Beans	Snip, Wash	6-7	Cut	.8	Steam Blanch	15-20 m	155°	135° F	40	12	6-10 hr	5-6%
Cabbage	Trim, Wash Core	15	Sliced	1.0	Steam Blanch	10-15 m	155°	135° F	40	12	6-8 hr	5-6%
Carrots	Wash, Peel Trim	18	Cube, Diced Shredded	1.5	Steam Blanch	5-10 m	155°	135° F	40	12	8-10 hr	5-6%
Celery	Trim, Wash	18	Slice, Shred	1.0	Steam Blanch	1-3 m	155°	135° F	40	12	8-10 hr	5-6%
			Leaves	.5	Steam Blanch	1-3 m	155°	135° F	40	12	3-6 hr	5-6%

(Continued)

VEGETABLES (Continued)

Product	Preparation	Waste %	Form for Drying	Tray Load	Pretreatment Type	Pretreatment Time	Drying Temp.[1] Max.	Drying Temp.[1] Min.	Humidity[2] Max.	Humidity[2] Min.	Drying Time	Final Moisture Content
					205°-212° F							
Corn	Husk, Wash	60	Cut	1.7	Steam Blanch	8-10 m	155°	135° F	40	12	5-8 hr	5-6%
Onions	Trim	7	Slice, Shred	1.2	Steam Blanch	1½-2 m	155°	135° F	40	12	5-8 hr	5-6%
Peas	Shell, Clean Grade	40	Whole	1.2	Steam Blanch	2-3 m	150°	130° F	40	12	8-10 hr	5-6%
Potatoes	Clean, Peel Trim	18-20	Slice, Shred Riced	1.2	Steam Blanch	5 m	155°	135° F	40	12	8-12 hr	6%
Pumpkin and Squash	Wash, Open Seed	25-30	Shred	1.5	Steam Blanch	5-7 m	155°	140° F	40	12	12-20 hr	5%
Spinach and Greens	Wash, Trim	45	Whole	.5	Steam Blanch	½-1 m	150°	135° F	40	12	6-8 hr	5%
Sweet Potatoes	Wash, Peel Trim	20-25	Sliced	1.5	Steam Blanch	8-10 m	160°	140° F	40	12	8-10 hr	5%
Tomatoes	Wash, Trim Peel	15-20	Sliced	1.2	Steam Blanch	3 m	150°	135° F	40	12	12-14 hr	3-5%

* Information contained in this table is taken partially from Circular 619, USDA, and partially from our investigations.

1/ Where temperatures are indicated, maximum temperature refers to hot end of drying tunnel and minimum temperature to cold end of drying tunnel.

2/ Humidities indicated are maximum which refers to the cold end of the drying tunnel and minimum referring to hot end of drying tunnel.

CIRCULATED AIR UNITS

O.A.C. Recirculation Type Dehydrator

Name	Address	County	Filling Capacity based on 3 lbs. per square foot tray surface tons
Luther, H. A.	Albany	Benton	13.50
Widmer Brothers	Albany	Benton	19.15
Davis, Mrs. Lena	Oregon City	Clackamas	3.30
Russell, Henry	Molalla	Clackamas	3.20
Baum, Mrs. A. W.	Roseburg	Douglas	9.60
Heard, Wm. Corvin	Looking Glass	Douglas	3.75
McGee, Guy	Canyonville	Douglas	7.38
Ruckhill, S. H.	Riddle	Douglas	6.95
Seely, M D, A. C.	Roseburg	Douglas	21.60
Eugene Fruit Growers	Eugene	Lane	33.15
Paetsch, Fritz	Lebanon	Lane	11.25
Schmitz, Jr., Peter	Eugene	Lane	8.28
McCall, Fred S.	Salem	Marion	15.93
Producers Co-op Pkg. Co.	Salem	Marion	37.50
Minty, George R.	Rickreall	Polk	15.00
Peters, D. D.	Dallas	Polk	8.55
Parson, P. R.	Forest Grove	Washington	20.25

Miller Type Dehydrator

Schmeiser, F. Carl	Oregon City	Clackamas	5.63
Bone, Roy	Glide	Douglas	4.23
Booth, J. H.	Roseburg	Douglas	4.33
Bounds, Mrs. V	Myrtle Creek	Douglas	4.13
Briggs, Ermel	Myrtle Creek	Douglas	11.65
Busenbark Brothers	Roseburg	Douglas	7.78
Clarke, R. R.	Oakland	Douglas	60.75
Epping, T. F.	Myrtle Creek	Douglas	14.25
Fisher, H. Eugene	Roseburg	Douglas	8.10
Henry, W. D.	Umpqua	Douglas	8.10
Trask, G. E.	Myrtle Creek	Douglas	7.88
Watson, J. C.	Roseburg	Douglas	4.28
J. Beebe & Son	Eugene	Lane	3.38
L. N. Miller Dehydrator Co.	Eugene	Lane	28.35
Scarbrough, C.	Creswell	Lane	46.58
Millhollen, Geo. H.	Albany	Linn	3.38
Adelman, Frank	Gervais	Marion	5.08
Simmons, Adams & Simmons	Salem	Marion	8.10
Way, W. E.	Salem	Marion	21.80
DeJong, Dick	Amity	Polk	1.98
Elliot, Fred Robert	Dallas	Polk	28.35
Elliot, W. M.	Dallas	Polk	17.55
Fern, Henry	Dallas	Polk	14.23

Miller Type Dehydrator (Continued

Name	Address	County	Filling Capacity based on 3 lbs. per square foot tray surface tons
Minty, George R.	Rickreall	Polk	13.60
Tarks, Edward	Monmouth	Polk	3.88
Allen, Edwin	Forest Grove	Washington	8.45
Gibson, U. B.	Forest Grove	Washington	3.38
Herb, J. Frances	Forest Grove	Washington	11.15
F. J. Lewis & Sons	Forest Grove	Washington	7.76
Montinore Farm	Dilley	Washington	17.33
Normandine, H.	Forest Grove	Washington	4.05

Puccinelli Type Dehydrator

Ball, Elbert	Riddle	Douglas	8.33
Burr, H. W.	Roseburg	Douglas	9.45
N. Curry Estate	Roseburg	Douglas	10.80
F. Fortin & Son	Umpqua	Douglas	10.13
Hebard, H. E.	Umpqua	Douglas	14.18
Smith, Clgy	Roseburg	Douglas	9.50
Winston, H. A.	Roseburg	Douglas	19.80
Brosi, Ivan S.	Eugene	Lane	8.78
Struckmeier, R. H. F.	Scio	Linn	9.38
Warden & Shepherd	Albany	Linn	7.35
Baker, A. W.	Dallas	Polk	9.45
Hildebrand, Adolph	Dallas	Polk	8.08
Minty, George R.	Rickreall	Polk	9.45
		TOTAL	762.51 tons

Oregon Tunnel Type Drier Remodeled with Fan

Fuller, W. A.	Albany	Benton	5.40
Parry, Hush	Oregon City	Clackamas	3.20
Tucker, W. W.	Estacada	Clackamas	3.63
Crawford Bros.	Estacada	Clackamas	7.93
Aikins, J. L.	Riddle	Douglas	7.33
Baird, A. B.	Oakland	Douglas	3.38
Bauer, H. J.	Riddle	Douglas	9.35
Buell, Roy	Looking Glass	Douglas	4.73
Clough, Huron W.	Canyonville	Douglas	7.23
Davison, W. A.	Oakland	Douglas	8.40
Eppinger Hilp Ranch	Myrtle Creek	Douglas	10.58
George, Perry W.	Oakland	Douglas	7.20
Hainer, Walter	Elkton	Douglas	34.93
Hutchinson, J. R.	Oakland	Douglas	8.40
Kamp, L. D.	Umpqua	Douglas	22.75
Kobbe & Son	Oakland	Douglas	3.45

Oregon Tunnel Type Drier (Continued)

Name	Address	County	Filling Capacity based on 3 lbs. per square foot tray surface tons
Larsen, A.	Looking Glass	Douglas	5.40
Madison, Geo. D.	Oakland	Douglas	21.65
Marks, C. Edward	Roseburg	Douglas	7.88
Mohr, C. W.	Roseburg	Douglas	8.40
Mortensen, James	Umpqua	Douglas	10.50
Paulsen, Henry	Umpqua	Douglas	9.45
Pruner, E. S.	Riddle	Douglas	4.23
Riddle, Glenn N.	Myrtle Creek	Douglas	13.40
Slatt, Albert	Roseburg	Douglas	7.88
Stearns, A. F.	Oakland	Douglas	7.00
Voohies, Ernest	Looking Glass	Douglas	8.40
Watzig, O. H.	Myrtle Creek	Douglas	8.10
Willis, W. W.	Canyonville	Douglas	11.15
Tripp Murphy & Lance	Albany	Linn	11.25
Allen Fruit Co., Inc.	Salem	Marion	91.13
Bowden, H. W.	Salem	Marion	4.23
Hrubetz, Frank	Salem	Marion	6.10
Wolf, A.	Aumsville	Marion	8.05
Aebi, E. F.	Dallas	Polk	7.00
Bartel, Dick	Dallas	Polk	8.10
Butz, Mrs. H. S.	Dallas	Polk	16.85
Dunn, A. Taylor	Dallas	Polk	19.38
Dyck, Isaak	Dallas	Polk	16.55
Egbiger, Abe	Dallas	Polk	13.50
Giesbrecht, David Sr.	Dallas	Polk	3.15
Hater, Margaret V.	Dallas	Polk	25.65
Neufeldt, P. John	Dallas	Polk	10.88
Neufeldt, Frank	Rickreall	Polk	43.33
Parrish, E. L.	Dallas	Polk	10.63
Plummer, L. W.	Dallas	Polk	13.50
Smith, Hugh	Dallas	Polk	15.20
Syron, Tom	Sheridan	Polk	7.85
Tilgner, John	Dallas	Polk	18.90
Voth, J. H.	Dallas	Polk	12.15
Holzmeyer, C. H.	Forest Grove	Washington	19.20
McDonald, H. C.	Banks	Washington	14.63
Wilcox, Fred	Banks	Washington	5.08
Kubin, W. Fred	Salem	Polk	10.13
		TOTAL	683.75 tons

NATURAL DRAFT TYPE DRIERS

Natural Draft Tunnel Type Drier

Name	Address	County	Filling Capacity based on 3 lbs. per square foot tray surface tons
Boggs, E.	Corvallis	Benton	13.68
Bystom, A.	Monroe	Benton	16.00
Rohmiller, Ben	Philomath	Benton	2.15
Fuller	Albany	Benton	7.77
Anderson, J. L.	Canby	Clackamas	2.20
Bates, F. W.	Estacada	Clackamas	4.08
Clarke, A. George	Mulino	Clackamas	25.33
Davis, F. Richard	Oregon City	Clackamas	8.60
Guttridge, Mrs. Joseph	Estacada	Clackamas	6.30
Miettunen, William	Mulino	Clackamas	3.65
Oldenburg, F. H. & A. A.	Mulino	Clackamas	15.48
Smid Broths	Oregon City	Clackamas	8.78
Swuffin, W. P.	Estacada	Clackamas	12.15
Tracy, J. H.	Estacada	Clackamas	4.23
Becker, F. A.	Roseburg	Douglas	3.65
Allen, Paul D.	Myrtle Creek	Douglas	1.85
Carter, John E.	Riddle	Douglas	11.03
Doerner, A. H.	Roseburg	Douglas	3.05
Dyer, A. L.	Myrtle Creek	Douglas	5.63
Ferguson, John H.	Days Creek	Douglas	6.33
Goff, C. A.	Oakland	Douglas	7.35
Johnston, Ralph E.	Riddle	Douglas	6.00
Kesterson, Keith	Oakland	Douglas	9.85
Knoght, Lou	Canyonville	Douglas	10.70
Larson, Herman R.	Oakland	Douglas	8.93
Leonard, Archie B.	Umpqua	Douglas	3.15
Shook, Evelyn	Roseburg	Douglas	2.10
Strader, Frank L.	Roseburg	Douglas	7.20
Thompson, L. E.	Umpqua	Douglas	12.80
Tuthill, Allen F.	Oakland	Douglas	4.73
Weaver, Franke	Riddle	Douglas	11.48
Nielsen, L. Niels	Eugene	Lane	34.65
Burkhart, Gladys	Lebanon	Linn	42.08
Dencer, Edw. W.	Salem	Marion	7.65
Dencer, Oscar L.	Salem	Marion	10.05
Denker, Brothers	Aumsville	Marion	10.50
Dunagan, M. T.	Scotts Mills	Marion	4.05
Feller, Wilfred	Turner	Marion	2.40
Mankerts, Ted F.	Salem	Marion	5.08
Marshall & Stolz	Salem	Marion	11.25
McKillop Brothers	Scotts Mills	Marion	14.45
Olden, W. D.	Salem	Marion	12.68
Schifferer Brothers	Turner	Marion	7.20

Natural Draft Tunnel Type Drier (Continued)

Name	Address	County	Filling Capacity based on 3 lbs. per square foot tray surface tons
Taylor, C. H.	Salem	Marion	11.48
Towle, J. E.	Aumsville	Marion	14.40
Rehfuss, H. F.	Salem	Marion	4.20
Stark, Walter	Salem	Marion	5.75
Waln, Fannie K.	Salem	Marion	12.70
E. Clemens Horst Co.	Independence	Polk	67.50
Chapman, R. L.	Dallas	Polk	51.23
McBee, L. H.	Dallas	Polk	5.50
Grice, S. Ammon	Salem	Polk	11.48
Skersies, Otto	Dallas	Polk	11.48
Kreason, R. S.	Dallas	Polk	20.25
Cady, M. P.	Hillsboro	Washington	.70
Edy, W. C.	Sherwood	Washington	9.60
Fryendall, W. V.	Banks	Washington	7.03
Haage, W. E.	Forest Grove	Washington	7.20
Hollenbeck, L. B.	Cornelius	Washington	4.95
Holscher, R. D.	Forest Grove	Washington	3.95
Marr, Ernest	Forest Grove	Washington	5.08
Muhly, Fred Sr.	Cornelius	Washington	2.10
Schmeltzer, John	Sherwood	Washington	5.00
Bailey, Orville	Forest Grove	Washington	1.13
Clapshaw, Carl	Forest Grove	Washington	9.45
Heisler, Harrison	Forest Grove	Washington	6.00
Rueter, E. A.	Forest Grove	Washington	16.45
Stack Type Natural Draft Drier			
Haberlach, G. F.	Clackamas	Clackamas	4.00
Commack, F. W.	Salem	Marion	9.65
Jones, H. R.	Salem	Marion	2.70
Bailey, Ervin	Forest Grove	Washington	7.40
Larsen, Louis	Forest Grove	Washington	5.00
		TOTAL	731.63 tons

Total Filling Capacity based on fresh prunes at the rate of 3 pounds per square foot of tray space 1,812.07 tons

The above plants are the returns from over 400 questionnaires sent to growers throughout the state. There are probably other growers who have not reported and therefore this list may not be complete.

Please Note: The dehydrators and the Oregon tunnel type driers remodeled with fan will dry prunes in from 24 to 26 hours. The natural draft tunnel type driers and stack type driers will dry prunes in about 48 hours. The total tonnage therefore indicated above indicates merely filling capacity.