Dehydration of Canadian Fruits

By
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DOMINION EXPERIMENTAL FARMS
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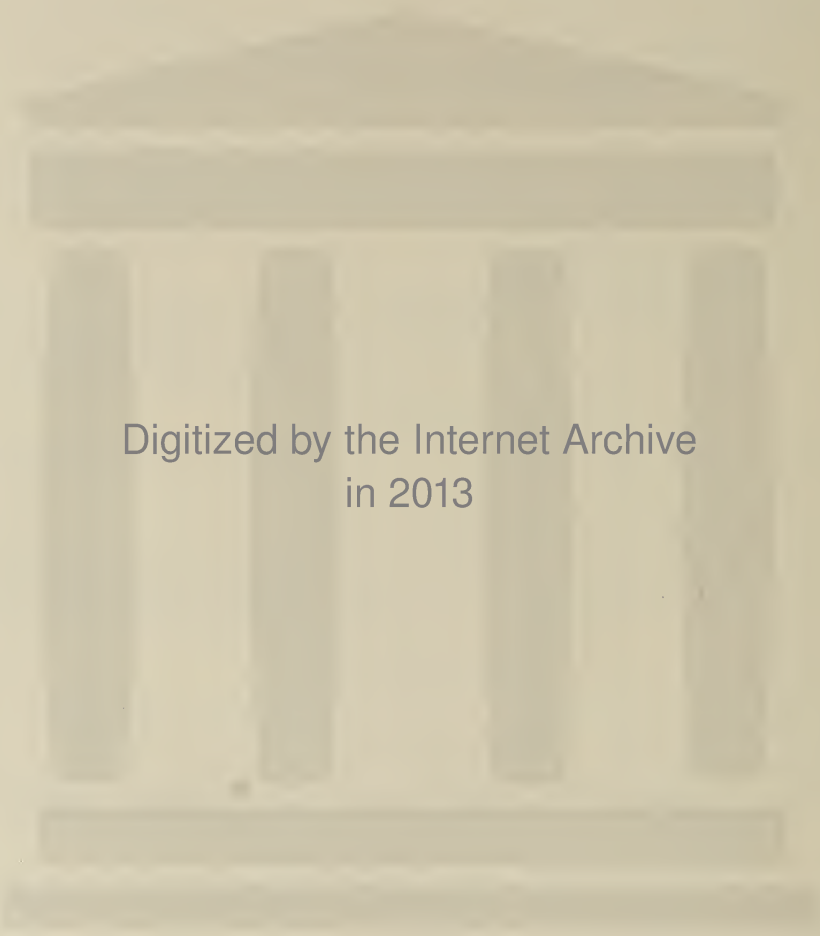


DEHYDRATION OF CANADIAN FRUITS

The immensity of the Canadian market for dehydrated fruits may be emphasized by the fact that for the three fiscal years ending March, 1929, the average annual importation of dried fruit amounted to 88,798,477 pounds[1]. The f.o.b. shipping point cost of this fruit plus duty was $7,394,895. Over a fifth of this amount or $1,514,012 was paid for dried prunes and apricots, two fruits that are being grown in the Dominion. The Dehydration Committee[2] has carried on experiments to determine the suitability of the varieties of these fruits grown in Canada for dehydration as well as extensive experiments with dehydrated apples. The results of these experiments together with outlines of commercial processes are given in this bulletin. The dehydration investigation has been carried on in a commercial plant at Grimsby, Ont., and in a semi-commercial plant originally located in Penticton, B.C., but now under the supervision of the Dominion Experimental Station, Summerland, B.C. Smaller experimental dehydrators have also been built at the Experimental Station at Saanichton, B.C., at the Central Experimental Farm, Ottawa, and at Kentville, N.S.

QUALITY OF FRUIT FOR DEHYDRATION

It is regrettable that growers in general feel that fruit which is worthless for fresh fruit shipment is quite suitable for the manufacture of fruit products. This is contrary to the actual situation and it is hoped that growers and shippers will give this point more consideration than in the immediate past.

Size

As fruit intended for dehydration is usually cut in half, in sectors, or sliced, it is quite imperative that it be of reasonable size in order to make a good appearing product. Small fruit is an economic curse to dehydrators due to the higher cost of preparation and the higher percentage of low-grade waste. These facts are amply illustrated in the following tables, the figures of which were compiled from data obtained in the Government plant at Grimsby, Ontario, during the 1929 season.

HOW SMALL SIZES INCREASE THE PERCENTAGE OF SKINS AND CORES

Variety	Size	Fresh weight	Peeled weight	Per cent of fresh weight	Dry weight	Weight of skins and cores	Per cent of fresh weight
	in.	lb.	lb.		lb.	lb.	
Greening	2½+	40,366	24,854	61·57	5,057	11,115	27·51
Greening	2¼–2½	41,558	23,418	56·35	5,130	14,624	35·20
Greening	2–2¼	28,870	15,618	54·10	3,760	11,052	38·28
Baldwin	2½+	28,843	18,420	63·86	3,866	8,839	30·64
Baldwin	2¼–2½	38,643	20,969	54·26	4,878	12,675	35·13
Baldwin	2–2¼	19,547	10,502	53·72	2,522	7,518	38·46

[1] These figures were compiled from "Commerce of Canada" for the years ending March 31, 1927, 1928 and 1929.

[2] The "Dehydration Committee" was appointed in May, 1923, and is as follows:—
E. S. Archibald, B.A., B.S.A., L.L.D., D.Sc., Director of Experimental Farms, Chairman.
Geo. E. McIntosh, Dominion Fruit Commissioner, Vice-president.
C. S. McGillivray, Chief Canning Inspector, Fruit Branch, Secretary.
F. T. Shutt, M.A., D.Sc., F.I.C., Dominion Chemist.
W. T. Macoun, D.Sc., Dominion Horticulturist.

Although the peeled weight percentage of the fresh weight does not decrease appreciably between the 2 to 2¼-inch and 2¼ to 2½-inch sizes, yet the grades for these sizes vary considerably. In the following table showing the grading of the above lots the total absence of Fancy quality in the 2 to 2¼-inch size is directly due to size as outlined on page 8.

Horticultural building on the Dominion Experimental Station, Summerland, B.C. Dehydration investigation is carried on in the left wing.

HOW SMALL SIZES LOWER THE GRADE

Variety	Size	Fancy	Choice	Standard quality
	in.	%	%	%
Baldwin	2½	100	.....	.....
Baldwin	2¼–2½	100	.....	.....
Baldwin	2–2¼	.....	100	.....
Greening	2½	100	.....	.....
Greening	2¼–2½	100	.....	.....
Greening	2–2¼	.....	94·93	5·07

The average dry weight percentage of the fresh weight was 12·55 per cent for Greenings and 13·06 per cent for Baldwins. No outstanding differences in yield were found with Russet, Spy, Cranberry Pippin and Blenheim.

HOW SMALL SIZES DOUBLE THE PEELING COST

An average ton of 2-inch apples contains	.....	16,318	fruits
" " 2¼-inch "	.....	13,035	"
" " 2½-inch "	.....	8,859	"

The same facts are relatively true in the case of prunes and apricots. An average price for dried prunes of 30/40 classification, f.o.b. packing house, often being three times that of 80/90's.

Maturity

Apples.—The most desirable dehydrated apples are made from fruit that is in prime condition for eating. Accordingly this product when dehydrated makes sauce or pies equal to that made from apples in autumn months. Apples dehydrated when too green are quite astringent, and a disadvantage from the standpoint of economy is the fact that immature fruit has a tremendous dry away. Apples dehydrated when over mature are flat in taste and more likely to contain rot.

Apricots.—Apricots for dehydrating are left on the tree until the latest time when they can be picked, pitted and placed on the trays without mushing. It is very desirable that full colour and flavour be developed in the fruit before it is picked.

Prunes.—Wherever possible prunes are allowed to drop on the ground. In the Okanagan Valley of British Columbia the fruit on odd trees begins to drop towards the end of September, but the main crop does not commence to drop freely until the early part of October. A good quality of dehydrated prunes can be made only from fully mature fruit.

Loganberries.—Loganberries are picked sufficiently firm to enable them to be hauled to the dehydrator, sorted, and trayed without mushing. Over-ripe berries also bleed badly during the dehydrating with a resultant large loss of juice. On the other hand care must be exercised to prevent the pickers from harvesting the fruit too green as this dehydrates to a poor product and has a much higher dry away.

Condition

It is wise to watch very closely for rots and other disease marks in fresh fruit bought for dehydrating. A rigid inspection should be maintained to safeguard against such disorders appearing in the prepared product.

PRINCIPLES OF DEHYDRATION

The three factors in the process of dehydration are heat, recirculation and humidity. The heat is required to activate the water contained in the fruit in order to change it to a vapour form. The function of the recirculation of the air is to carry this vapour away from the fruit, and as the air would eventually become saturated with moisture, a small amount of dry air is taken into the dehydrator while a like portion of moist air is given off. A definite humidity for each fruit is maintained to prevent a rapid drying of the outer cells of the skin with consequent "case hardening." If this condition occurs it is difficult to extract the water from the fruit as there are no openings in the skin by which it can escape. The speed of dehydrating depends on the relationship of these factors to one another. For instance, high temperature with poor circulation would not be better than a low temperature with high circulation. The need of humidity will depend on the type of fruit being dehydrated.

DEHYDRATION OF APPLES

Opportunities for Dehydrating of Apples in Canada

[1]Canada now supplies the home market for dried apples, and during years of good crops exports nearly 2,000,000 pounds. On the other hand the United States besides supplying their domestic market, have doubled their exports since 1922.[2] In that year the United States exported 17,391,339 pounds of dried

[1] Statistics in "Commerce of Canada" show an importation of dried apples from the United States of from one to two million pounds annually. However, this is really apple pomace for the jam plants, and sells for about three cents a pound.

[2] These figures were compiled from "Foreign Commerce and Navigation of the United States" for the years 1922-1928.

apples valued at $2,210,233. In 1928 they exported 35,068,394 pounds with a value of $4,144,533. Canada produces thousands of tons of apples annually that are unfit for fresh fruit shipment but suitable for dehydration.

Quality must be improved

Quantity rather than quality production has had its obvious effect on the market for dehydrated apples. Although with modern equipment the dehydration of apples can be very largely a mechanical process, careful personal inspection is still of first importance. The building of larger markets will be achieved, to a large extent, through improvement in quality of the produce. Machine industry is quite desirable from the standpoint of economical and uniform production, but when used in the preparation of fruit it must have adequate personal supervision.

Washing Fruit

In general, apples for dehydrating are not washed before being treated although this is a very desirable practice. Where washing is included it is the first operation in the preparation.

Grading

From the washer the applies are conveyed to the grader where they are graded into lots according to their diameter. Apples smaller than 2 inches in diameter are either made into chop or returned to the grower. The sizes of 2 to $2\frac{1}{4}$ inches, $2\frac{1}{4}$ to $2\frac{1}{2}$ inches, etc., are conveyed to peelers.

Paring Machines

Several types of paring machines are on the market, which peel, core and cut the apple into sectors. These then pass on an inspection belt before a row of women who pick off culls or pieces which need additional workmanship. Besides the machine mentioned above, there are many simpler types which pare, core and slice, or do a part of these tasks.

Modern plants are also equipped with "seed cellers" to remove the last fragments of the core. This operation is done after the apples are peeled and cored and before they are cut.

Traying and Sulphuring

The peeled and cored fruit is spread on trays at the rate of about 2 pounds to the square foot. The loaded trays are placed on a small car, on which they may be easily transported, and when a full carload is prepared, the car and fruit is placed in a sulphur chamber. Here the fruit is exposed to sulphur fumes for 20 to 35 minutes. In small plants where the preparation is slow and where browning may be excessive, the fruit is sometimes dipped in a dilute salt solution (2 to 5 per cent). If this practice is followed the sulphuring period may be reduced to 15 or 20 minutes. Apples are often sliced before sulphuring but the former method is gaining in popularity.

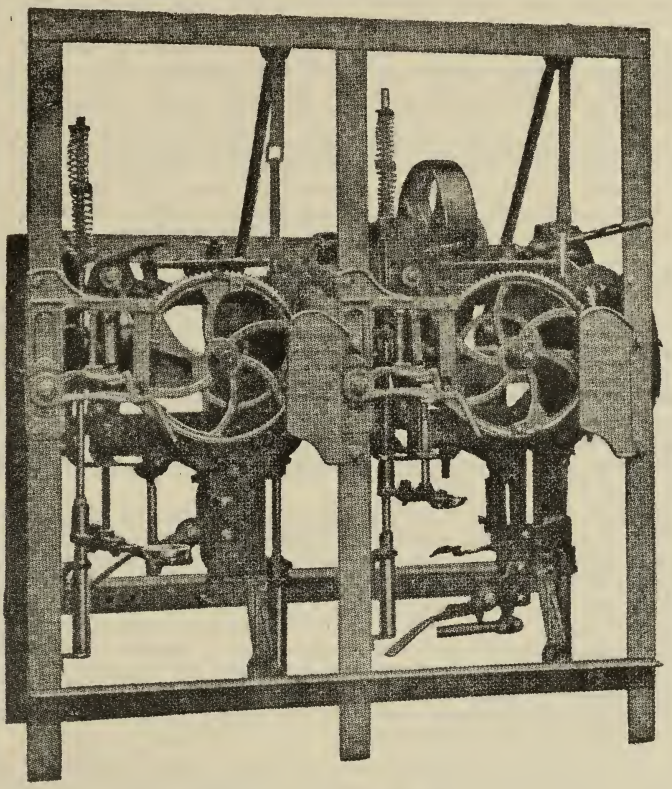
Operation of Dehydrating

Upon removal from the sulphur chamber, the car and its load is placed in the cooler end of the dehydrator. Here the temperature will approximate 125° to 130° F. with a relative humidity of 5 to 10 per cent. In the hot end of the tunnel the temperature will be about 30 degrees higher. The car of prepared fruit progresses through the tunnel, the actual time for the dehydrating varying with the type and efficiency of the dehydrator. Although the "Meat and Canned

Foods Act" allows a moisture content of 25 per cent, it has been found through experiments at Grimsby that 22·5 per cent moisture is a safer content to dry to as the remaining 2·5 per cent may be considered as a surety to prevent exceeding the tolerance. There is also the ever present possibility of shrinkage where the moisture content is high, resulting in complaints from the trade.

Curing

After the fruit has been removed from the dehydrator and has cooled, it is dumped from the trays into curing bins. These are often arranged so that the fruit can be mechanically turned every second day for six days by having several floors (one above the other) on hinges. During a "turning" the fruit falls from one floor to the next. The fruit is moved in this manner, or turned with a shovel, to prevent heating and consequent spoilage. By turning the fruit, the curing is encouraged which results in all pieces being of equal moisture content.



Pease apple paring machine.

Grades

The requirements of the various grades of dehydrated apples, as outlined in "The Meat and Canned Foods Act," 1929, pages 29, 30 and 31, are as follows:—

"Fancy Quality Dehydrated Apples" (slices and rings) shall be packed from sound, firm ripe apples not less than 2½ inches in diameter which have been properly peeled, cored and trimmed, and when prepared, are free from worm holes, scab, etc. The finished stock shall be 90 per cent whole rings, 90 per cent free of pieces of skin and core, 70 per cent uniform in size and not more than 5 per cent shall pass through a screen ¾-inch square openings. The colour of the product shall be as white as the natural colour of the fruit

used in the manufacture and shall not vary more than 10 per cent. Only one variety of apples shall be used in this grade and the name of that variety shall be shown on the label, carton, container or other lithograph design in type reasonably proportionate to the size of the other printing on the label, etc., but in no instance shall it be less than $\frac{3}{8}$ of an inch in height. No smoke odour or other defects will be permitted.

"Choice Quality Dehydrated Apples" (slices and rings) shall be packed from sound, firm, ripe apples not less than 2 inches in diameter which have been properly peeled, cored and trimmed, and when prepared, are free from worm holes, scab, etc. The finished stock shall be 80 per cent whole rings, 80 per cent free of pieces of skin and core, reasonably uniform in size and not more than 5 per cent shall pass through a screen $\frac{5}{8}$ inch square openings. The colour of the product shall be as white as the natural colour of the fruit used in the manufacture, and shall not vary more than 20 per cent. Only apples of similar varieties shall be used in this grade and the name of that variety shall be shown on the label, carton, container or other lithograph design in type reasonably proportionate to the size of the other printing on the label, etc., but in no instance shall it be less than $\frac{3}{8}$ of an inch in height. No smoke odour or other defects will be permitted.

"Standard Quality Dehydrated Apples" (slices and rings) shall be packed from sound, firm, ripe apples which have been properly peeled, cored and trimmed, and when prepared are free from worm holes, scab, etc. The finished stock shall be 60 per cent whole rings, 70 per cent free of pieces of skin and core, reasonably uniform in size and not more than 10 per cent shall pass through a screen $\frac{1}{2}$ inch square openings. The colour of the product shall be as white as the natural colour of the fruit used in the manufacture and shall not vary more than 50 per cent. No smoke odour or other defects will be permitted.

"Second Quality Dehydrated Apples" (slices and rings) may be packed from apples from which all decomposed, bruised or other objectionable portions have been removed. The fruit shall be properly peeled, cored and trimmed but need not necessarily be uniform in size, colour or variety. The slices shall be 50 per cent free from skin or core and not more than 5 per cent shall pass through a screen $\frac{1}{4}$ inch square openings.

"Fancy Quality Dehydrated Apples" (quarters, sixths and eighths) shall be packed from sound, firm, ripe apples not less than $2\frac{1}{4}$ inches in diameter, which have been properly peeled, cored and trimmed, and when prepared, are free from worm holes, scab, etc. The finished stock shall be 90 per cent free of pieces of skin and core, 80 per cent uniform in size and not more than 5 per cent shall pass through a screen $\frac{3}{8}$ inch square openings. The colour of the product shall be as white as the natural colour of the fruit used in the manufacture and shall not vary more than 10 per cent. Only one variety of apples shall be used in this grade and the name of that variety shall be shown on the label, carton, container or other lithograph design in type reasonably proportionate to the size of the other printing on the label, etc., but in no instance shall it be less than $\frac{3}{8}$ of an inch in height. No smoke odour or other defects will be permitted.

"Choice Quality Dehydrated Apples" (quarters, sixths and eighths) shall be packed from sound, firm, ripe apples not less than 2 inches in diameter which have been properly peeled, cored and trimmed, and when prepared are free from worm holes, scab, etc. The finished stock shall be 80 per cent of pieces of skin and core, 70 per cent uniform in size and not more than 10 per cent shall pass through a screen $\frac{1}{4}$ inch square openings. The colour of the product shall be as white as the natural colour of the fruit used in the manufacture and shall not vary more than 20 per cent. Only apples of similar varieties shall be used in this grade and the name of that variety shall be shown on the label, carton, container or other lithograph design in type reasonably proportionate to the size of the other printing on the label, etc., but in no instance shall it be less than $\frac{3}{8}$ of an inch in height. No smoke odour or other defects will be permitted.

"Standard Quality Dehydrated Apples" (quarters, sixths and eighths) shall be packed from sound, firm, ripe apples, which have been properly peeled, cored and trimmed, and when prepared are free from worm holes, scab, etc. The finished stock shall be 70 per cent free of pieces of skin and core, reasonably uniform in size and not more than 20 per cent shall pass through a screen $\frac{1}{4}$ inch square openings. The colour of the product shall be as white as the natural colour of the fruit used in the manufacture and shall not vary more than 50 per cent. No smoke odour or other defects will be permitted.

"Second Quality Dehydrated Apples" (quarters, sixths and eighths) may be packed from apples from which all decomposed, bruised or other objectionable portions have been removed. The fruit shall be properly peeled, cored and trimmed, but need not necessarily be uniform in size, colour or variety. The pieces shall be 50 per cent free from skin or core and not more than 50 per cent shall pass through a screen $\frac{1}{4}$ inch square openings.

Note: In the foregoing definitions the term "White as the natural colour of the fruit used" shall not be deemed to apply to unbleached quarters, sixths and eighths.

APPLE DEHYDRATION PROJECTS IN PROGRESS

Dehydrating Domestic and C Grade Cookers for Export

Besides endeavouring to utilize the actual cull apples, the Dehydration Committee has been experimenting with a product made from fruit that would normally be shipped as "Domestic" or C grade cookers. One hundred and twenty-three tons were dehydrated in the Grimsby plant during the 1929 season. In the preparation, this fruit was peeled, cored and cut into longitudinal sectors. These sectors were then placed on trays, sulphured and dehydrated.

The advantages of processing this grade of cooking apples in this manner for the domestic or export market may be outlined as follows:—

1. The cost of transportation is reduced approximately seven-eighths.
2. The apples have the same nutritive value during spring months as in fall when dehydrated.
3. Packing and storage costs are reduced.
4. Only the flesh of the apple is transported.
5. The peeling, slicing and coring is done by machinery before dehydrating, and is much cheaper than the hand operations of the bakery.
6. The product can be stored for a much longer period than the fresh fruit.
7. It is very easily refreshened and made ready for use.
8. The sectors give the body of the pie the same appearance as that made from fresh fruit.
9. The quality of the dehydrated apple is not materially damaged by rough handling in transit.

These facts from the cost standpoint are explained in detail in the ensuing paragraphs.

Cost of Marketing Domestic or C Grade Cooking Apples

The cost of marketing apples of Eastern and Western Canada varies considerably due to the different methods of packing. The situation in Eastern Canada where apples are barreled in the orchard is quite different from the procedure in British Columbia where the apples are hauled to central plants for grading, packing and shipping. As a consequence, two tables of costs are provided, dealing with the eastern and western conditions respectively.

COST OF MARKETING 100 POUNDS OF DOMESTIC GRADE ONTARIO APPLES ON THE BRITISH MARKET

	$
Picking	0 14
Cost of barrel	0 54
Packing	0 25
Cost of transportation and selling charges in England	1 43
Hauling and storage	0 07
Total	2 43
Average cost per pound	0·0243

[2]COST OF MARKETING 100 POUNDS OF C GRADE BRITISH COLUMBIA COOKERS ON THE BRITISH MARKET

	$	Per box 41 pounds $
Cost of picking	0·073	0 03
Cost of hauling out of orchard	0·024	0 01
Cost of hauling to packing house	0·049	0 02
Packing charges (shook, making of box, packing, etc.)	0·975	0 40
Transportation charges	2·80	1 15
Marketing charges	0·17	0 07
Storage	0·146	0 06
Total Cost	4·237	1 74
Average cost per pound	0·042	0·042

[1] Figures from Dominion Fruit Branch, Ottawa.
[2] Average cost figures as compiled by the Penticton Co-operative Growers, Penticton, B.C.

Rather than packing C grade cookers and shipping them fresh, experiments have shown that it is a more logical practice to separate them when packing the higher grades, and to dehydrate the "Domestic" or C grade. Charges on British Columbia C grade fruit for dehydrating, therefore, include hauling charges to the packing house.

COSTS OF DEHYDRATING 100 POUNDS OF C GRADE BRITISH COLUMBIA APPLES AND DELIVERING SAME ON BRITISH MARKET

	cts.
Cost of picking	7·3
Cost of hauling from orchard	2·4
Cost of hauling to central packing house	4·9
Piece work	16·0
Day work	14·0
Power (for fan)	2·0
Fuel	2·64
Overhead	22·0
Cost of case	6·25
Packing, insurance and strapping	1·75
Transportation	17·50
Marketing	2·0
Total	98·74

The yield of dehydrated apples from a hundred pounds of fresh fruit will approximate 12½ pounds, giving an average cost of 7·9 cents per dried pound.

As a pound of dehydrated apples is equal to approximately eight pounds of fresh apples, the cost of a pound of actual apple flesh from British Columbia landed in England is one cent, and the cost of the same amount from Ontario is still lower.

With dehydrated apples, costs of preparation should be taken into consideration as the baker is relieved of this charge. Accordingly, an English baker could afford to pay a little more per pound for a proportional weight of dehydrated apples, as his own preparation costs are reduced.

In the spring months the dehydrated apple is a superior product as it is of the same quality as when dehydrated in the autumn, while the fresh apple is past its prime.

Transportation Costs of Dehydrated versus Canned Apples

A comparison of dehydrated and canned apples logically centers on costs per unit of delivering the respective products on the market. In the "Meat and Canned Foods Act" of 1929 the minimum weight of apples packed in water required per number 10 can is 64 ounces, and a minimum net weight of all contents of 94 ounces. The 64 ounces of apple, if dehydrated would yield approximately 15·19 ounces and with its carton would not weigh more than 17 or 18 ounces. The total weight of the same amount of fruit canned plus the can is nearly 7 pounds. In addition to the transportation charges on the canned fruit, the cost of the can is practically one cent per pound of contents while the cost of the cartons for the dehydrated fruit (if purchased in similar volume to the can purchases) would be from one and a half to two and a half cents a pound of dehydrated product. Cellophane packages will cut this down to one cent a dehydrated pound. The cost of wooden or fibre cases for the canned goods is almost nine times the cost of cases for the dehydrated fruit. The weight differential on a case of canned apples as compared with a case of dehydrated is explained as follows:—

Canned Apples—

1 case weighing approximately 50 pounds, of 6 No. 10 cans contains 6 x 64 = 384 ounces prepared apple.

Dehydrated Apples—

1 case weighing approximately 50 pounds, contains 211 pounds prepared fruit or 3,376 ounces.

$3376 \div 384 = 8 \cdot 7$

One 50-pound case of dehydrated apples thus holds the actual fruit contained in nearly nine cases of canned apples.

Dehydrated versus Evaporated Apples

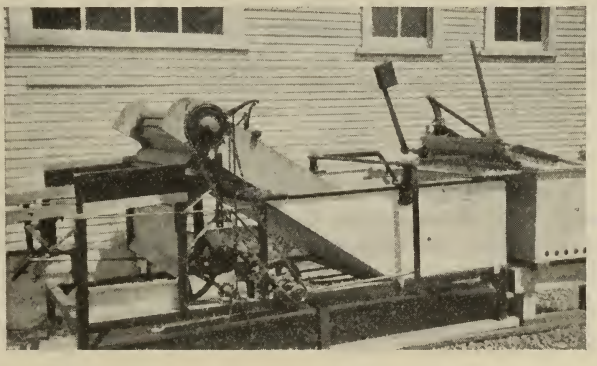
Dehydrated apples are often confused with evaporated fruit. It must be borne in mind, however, that dehydrated apples are made under absolutely sanitary conditions, the actual process of dehydrating being a sterilizing agent, and also that the excess water is removed in five or six hours while the evaporated apple is only slowly dried. The nutritive value of a dehydrated apple is practically the same after the process while the same cannot be said of evaporated apples.

DEHYDRATION OF PRUNES

As factors such as maturity and condition of prunes for dehydration have already been mentioned the actual dehydration and related processes may be discussed directly.

Lye Dipping

Prunes are dipped in a weak lye solution of approximately $1\frac{1}{2}$ per cent to slightly check the skin and consequently facilitate the removal of their excess moisture. The amount of lye necessary to check the skin varies with the districts in which the fruit is grown. Consequently trial batches have to be made to determine the amount of lye needed. Too much lye causes unnecessary damage by cracking the skin and dissolving the skin pigments and consequently dehydrated prunes that are subjected to strong lye become dull and lack the shiny black colour of those dipped in a weak solution. The solution is held just below the boiling point and the prunes are immersed for a period of 2 to 4 seconds. Immediately upon their removal from the lye solution they are placed in clean cold water. From this they are trayed and placed in the dehydrator.



Prune lye dipper, trayer, washer and trayer.
(Courtesy Miller Dehydrator Co., Eugene, Oregon.)

Operations in Dehydration of Prunes

The fruit is then placed in the dehydrator where the temperature ranges up to 165° F. The relative humidity is maintained at between 15 and 25 per cent, eighteen being the most desired percentage. The drying time will vary with the type of dehydrator but will approximate 20 to 24 hours.

Curing and Packing

The prunes are stored in bins where the moisture content between individual fruits is equalized. The fruit is removed from these bins at the end of the season, is graded, processed in boiling water for three minutes, and packed in suitable containers. At present, the large quantities are packed in 25-pound wooden cases lined with wax paper but the trend is towards containers of one and two pound capacity.

Prune Dehydration Projects in Progress

Most of the experimental dehydration of prunes in Canada has been limited to the Okanagan Valley of British Columbia. The aim of the investigation is to determine the possibilities of the industry and to ascertain the most adaptable varieties for dehydrating.

Variety Tests

Besides hardiness and good cropping habits, the three most important qualities of the fruit that have been sought are: (1) a sugar content sufficiently high to compare favourably with that of the imported products; (2) attractive flavour; and (3) good appearance in the finished product. The following table outlines the results obtained:—

QUALITIES OF PRUNE VARIETIES TESTED FOR DEHYDRATING

Variety	Date of ripening	Size of fruit	Texture	Sweetness	Flavour	Appearance
French Petite	Sept. 13-23	Small	Good	Good	Good	Good
Mammouth French	Sept. 12-23	Small to medium	Good	Good	Good	Good
Date	Sept. 12-23	Small	Good	Good	Good	Good
Italian	Sept. 23-Oct. 15	Medium to large	Good	Good with earlier part of crop.	Good	Good
Silver	Oct. 1-10	Large	Good	Fair to good	Fair to good	Fair
Yakima	Sept. 6-12	Extra large	Good	Fair	Fair	Poor
Monarch	Sept. 11-23	Medium	Poor	Poor	Poor	Poor
Standard	Sept. 12-22	Medium	Very soft	Poor	Poor	Poor

In the above it may be noted that the French Petite, Mammouth French, Date, and Italian prunes are promising varieties. Unfortunately, however, there are disadvantages in each case. Generally speaking the French Petite, Mammouth French, and Date produce frail trees which are inclined to bear large crops of small fruit. Even when the trees are young the fruit does not attain a reasonable size for dehydrating. The Italian, on the other hand, is a hardy variety but matures late in the season. During autumns with a great deal of cloudy weather many of the individual fruits do not develop as much sugar as is desired. However, an early ripening bud sport of this variety has been found and is being propagated at the Dominion Experimental Station, Summerland, B.C. This strain ripens to full maturity by the end of August and small samples that have been dehydrated have been more uniformly sweet and thus of higher quality than the ordinary strain of Italian prune.

DEHYDRATION OF APRICOTS

Cutting

The fruit as soon as received from the orchard is cut and the halves laid on trays with the pit cavity up. It is imperative to guard against careless cutters slipping the pit out of the fruit and tearing it in half. Even the best fruit if handled in his manner makes only a very low grade product.

Traying

The ideal situation is to have the apricots as close together as possible without touching. Little is gained by crowding as the apricots stick together when they start to dry and pull one another into undesirable shapes. Full trays are loaded on cars and run into sulphur chambers.

Sulphur Chambers

The sulphur houses in use at this Station are of double thickness board construction with building paper between the boards. Each chamber is just large enough to comfortably accommodate one car of trays and has a ventilator at both the top and bottom. There are many more elaborate plans for sulphur chambers but the aforementioned is the simplest and is sufficient for local needs at the present time. Whatever the type, it is essential that the sulphur chamber be practically air tight to prevent leaks during sulphuring.

Sulphuring

Seven pounds of sulphur per green ton has been used with satisfactory results. The sulphur should be of a grade free from arsenic and dry enough to burn easily. If difficulty is encountered in causing complete combustion of the sulphur, three to four per cent of powdered sodium or potassium nitrate added to the sulphur will overcome this difficulty. The simplest method of burning the sulphur is to place it in a shallow tin plate, supported at least an inch above the floor. The sulphur may be ignited with burning shavings or with hot coals. The ventilator on top of the chamber is kept open until the sulphur fumes begin to pass out quite freely. Apricots for dehydrating are exposed from one to two hours.

Operations in Dehydration of Apricots

Upon removal from the sulphur chambers the trays are placed in the dehydrator where the air is heated to 135° F. while a relative humidity of 15 per cent is maintained. The temperature never exceeds 150° F. at any time to avoid caramelizing the sugars. The apricots are sufficiently dried when they will not remain in a ball when squeezed in the hand. Apricots that crack when pressed have been dried too much. This dried fruit is next placed in clean wooden bins where it cures until the end of the season.

Processing

In California where this industry is extensively developed the dried fruit is sold by the grower to a processing and packing company. Here the apricots are sorted, graded, resulphured, and steamed to a definite moisture content (around 22 per cent). While the fruit is still hot it is pressed into paper lined cases.

Apricot Dehydration and Sun Drying Experiments in Progress

Much of the work in dehydrating and sun drying of apricots has been centered around variety tests, and although the results have shown Royals, Blenheim, and Tilton to be the best varieties grown in Canada, the Wenatchee Moorpark is the most hardy and the heaviest bearing. This work thus resolves itself into investigation whereby the Wenatchee Moorpark variety can be dehydrated or sun dried to produce a high quality product. The two projects on this subject may be outlined as follows:

Minimum Sulphur for Dehydrated Apricots

Although sulphur dioxide is a preservative and is sometimes used in excessive amounts in foods, it is essential to use a certain amount to preserve an attractive colour in dried fruit. It has also been proven by experiments conducted in California, that sulphur dioxide preserves the vitamin C content of the fruit. It is thus apparent that sulphur dioxide is necessary in dehydrating or sun drying fruit but the minimum amount that will give these desirable qualities is still undecided and an experiment has been outlined to investigate this problem.

Sun Drying for Colour

As the colour of sun dried apricots is much richer than that of the dehydrated fruit an experiment has been outlined in which the apricots are partly dried in the sun to develop colour and are then placed in the dehydrator where the removal of the remaining excess water is completed. It is expected that this method will yield a product with the desirable colour of the sun dried fruit with the greater cleanliness and reduced risk of danger from inclement weather.

Costs of Production

During years of small crops and high prices for fresh apricots it would not be practical to dehydrate the fruit, but in years of bumper crops and low prices dehydration may provide a worthwhile outlet for part of the crop and thus bolster the price of that sold fresh.

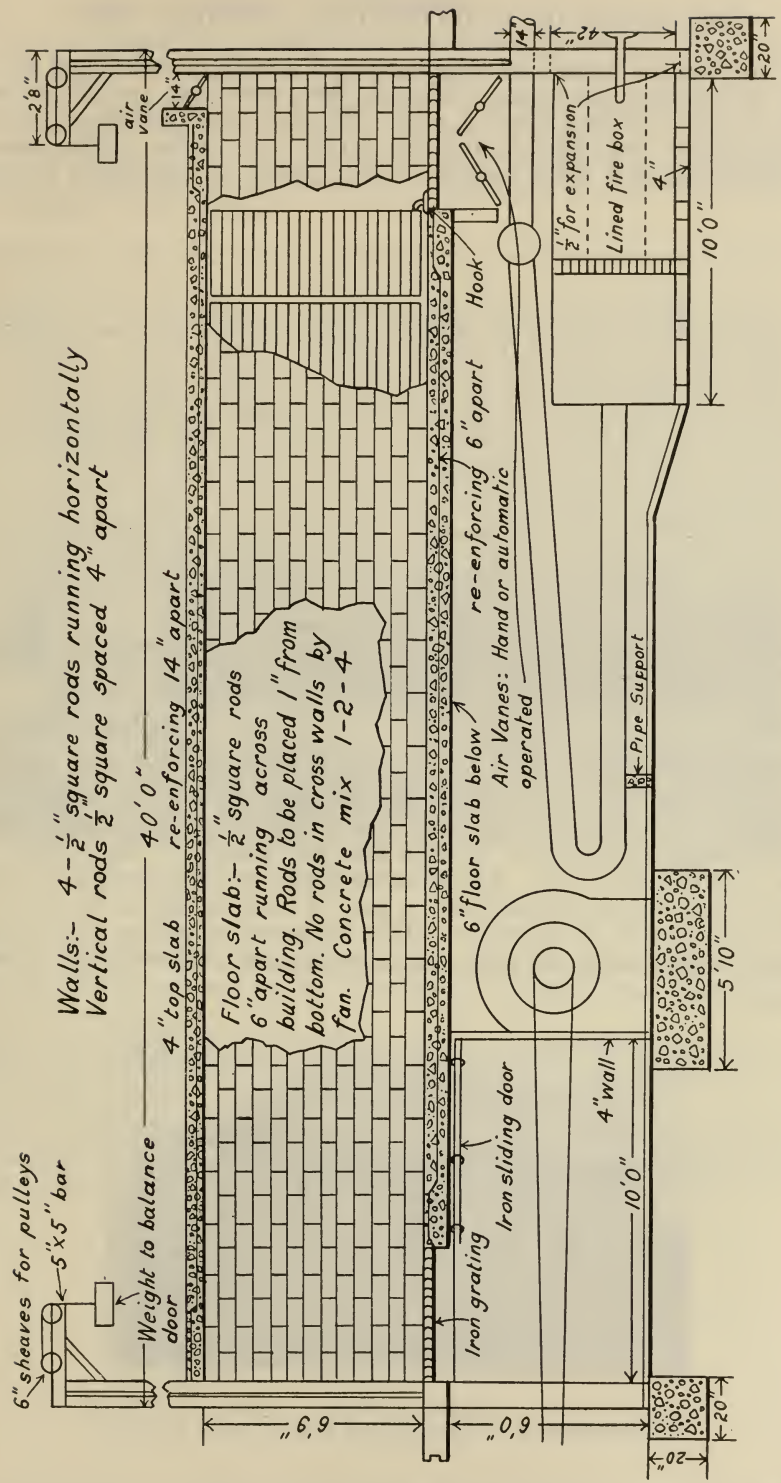
In order to determine the practicability of growing apricots for these products the Dehydration Committee has planted a five-acre apricot orchard at Osoyoos, B.C., where all costs are recorded. This will provide a fund of information when in full bearing.

DEHYDRATION OF PEACHES

Although the dehydrated product from this fruit is quite satisfactory, the peach surplus is not a serious factor. The fresh market and the canneries can consume more peaches than are being produced in Canada and can pay a price considerably in excess of what could be paid for the same fruit for dehydrating. If the peach growing industry is developed sufficiently for a surplus to exist after filling the two markets already mentioned, dehydration could take care of considerable tonnages.

The following table gives the drying ratio and percentage of pit for several peach varieties:—

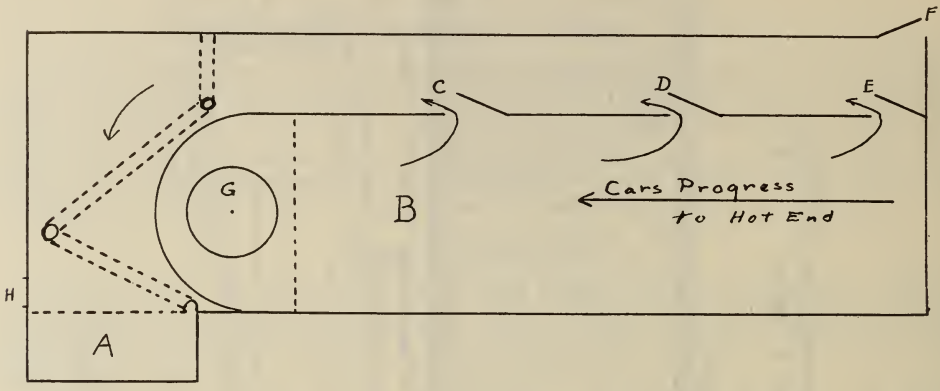
Variety	Drying ratio	Percentage pits
Elberta	9·8—1	8
Early Crawford	9·0—1	6·4
Late Crawford	10·4—1	.....
J. H. Hale	6·8—1	8
Tuscan Cling	12·9—1	.....
Muir	5·8—1	.....



Cross section of an O.A.C. type dehydrator.

PRINCIPLES OF DEHYDRATOR CONSTRUCTION

The recirculation tunnel dehydrator is now generally considered the most economic and satisfactory type. Although there are many modifications, the principle involved is essentially the same. The two most popular types in the northwest, namely the [1]Miller, and the [2]O.A.C. are quite similar in actual tunnel construction but differ mainly in the method of circulating the heated



Cross section of diagram of Miller type. (A) heating unit, (B) tunnel, (C, D, and E) ventilators in top of tunnel. (F) moist air outlet, (G) multivane fan, (H) fresh air inlet. Arrows through "C", "D", and "E" indicate course of air.

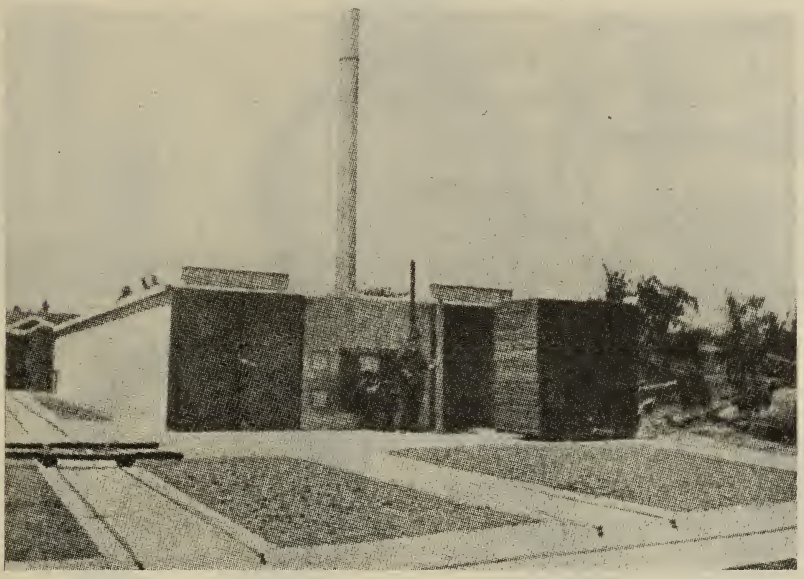
air. Whereas the O.A.C. type, illustrated in the accompanying graph, has the heating unit and fan in a duct below the main tunnel, the Miller type has this equipment at one end of the tunnel as illustrated in the other graph. In the O.A.C. dehydrator the air travels the full length of the tunnel before returning to the heating unit. In the latter type provision is made for part of the air to return to the heating unit at two or more places in the roof of the tunnel (C, D, and E of diagram). This construction allows for an upward movement of air through the trays and increases the uniformity of the drying.

The mechanism of a Miller dehydrator. Note the plastered tile construction, oil burners, and electric motor for fan.

[1] Patented by the L. N. Miller Dehydrator Co., Eugene, Oregon.
[2] Designed by Prof. E. H. Wiegand, Oregon Experiment Station, Corvallis, Oregon.

Materials

Heating Unit.—The heating unit will depend directly on the type of fuel to be used. Oil, wood and coal are being used, depending on which is cheapest in regard to its cost and yield of B.T.U.'s. In dehydrators operated as sidelines of canneries where steam is available, this source of heat is very satisfactory. It is not economical, however, to instal steam where only a dehydrator would be supplied. The size of the furnace and radiating pipes will depend directly on the capacity of the plant.



Puccinelli dehydrator.

Walls.—Permanent plants are largely constructed of hollow tile. This is free from cracks and can easily be plastered giving a fine clean appearance and suitable insulation.

Floor.—It is advisable to use reinforced concrete for cleanliness, strength and permanence.

Doors.—The doors are usually made of wood covered with sheet metal. This maintains a tight surface and overcomes the difficulty caused by cracks in wooden doors.

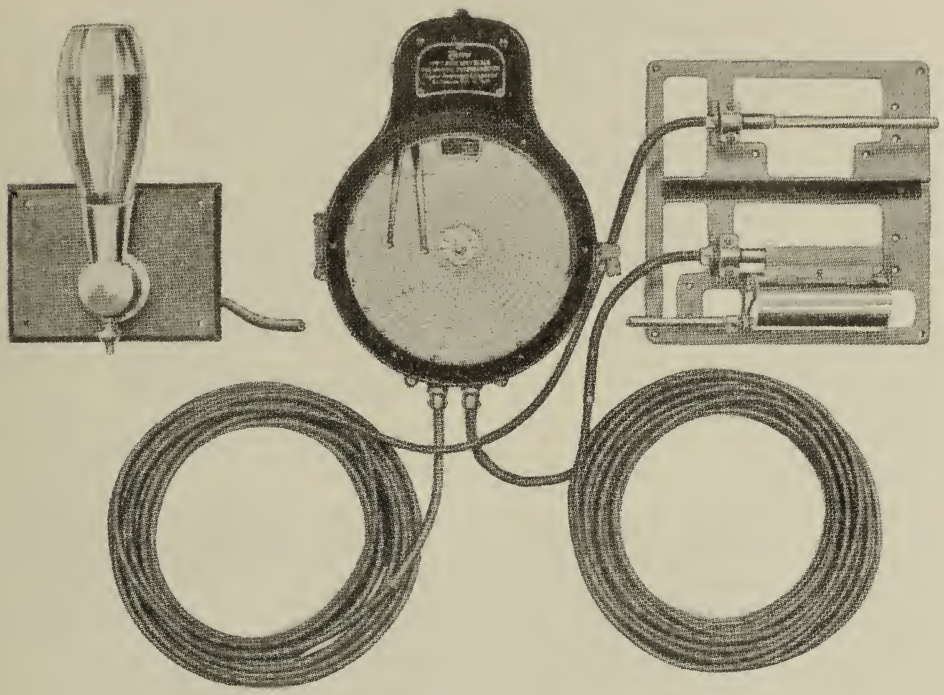
RELATIVE HUMIDITY TABLE

Wet Bulb Temperatures, Degrees Fahrenheit

Dry Bulb Temperatures. Deg. F Temp.	215	210	205	200	195	190	185	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60
215	100	91	82	73	66	60	55	47	42	37	32	29	25	22	19	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
210	....	100	90	81	73	66	58	42	46	41	36	32	28	24	21	18	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
205	....	....	100	90	81	72	65	58	51	45	40	35	31	27	23	20	17	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
200	....	....	....	100	90	81	72	64	57	51	45	39	34	30	26	22	19	16	....	....	....	....	....	....	....	....	....	....	....	....	....	....
195	....	....	....	....	100	90	80	72	64	57	50	44	38	33	29	25	21	18	15	....	....	....	....	....	....	....	....	....	....	....	....	....
190	....	....	....	....	....	100	90	80	71	63	57	49	43	37	32	28	24	20	17	14	....	....	....	....	....	....	....	....	....	....	....	....
185	....	....	....	....	....	....	100	90	80	71	62	55	48	42	37	31	27	23	19	16	13	....	....	....	....	....	....	....	....	....	....	....
180	....	....	....	....	....	....	....	100	89	79	70	62	54	47	41	35	31	26	22	18	14	12	....	....	....	....	....	....	....	....	....	....
175	....	....	....	....	....	....	....	....	100	88	78	69	61	53	46	40	35	30	25	21	17	13	10	....	....	....	....	....	....	....	....	....
170	....	....	....	....	....	....	....	....	....	100	89	78	69	60	52	45	39	33	28	24	18	15	12	9	....	....	....	....	....	....	....	....
165	....	....	....	....	....	....	....	....	....	....	100	88	78	68	59	49	44	38	32	27	22	18	14	10	8	....	....	....	....	....	....	....
160	....	....	....	....	....	....	....	....	....	....	....	100	88	77	66	57	50	43	37	31	25	21	17	13	9	6	....	....	....	....	....	....
155	....	....	....	....	....	....	....	....	....	....	....	....	100	88	77	66	57	49	42	36	29	24	19	15	11	8	4	....	....	....	....	....
150	....	....	....	....	....	....	....	....	....	....	....	....	....	100	87	76	66	57	48	41	34	28	23	18	14	9	6	2	....	....	....	....
145	....	....	....	....	....	....	....	....	....	....	....	....	....	....	100	87	75	65	56	47	39	33	27	21	16	12	8	4	....	....	....	....
140	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	100	87	75	64	54	46	38	31	25	19	14	10	6	2	....	....	....
135	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	100	86	74	63	53	44	36	30	23	18	12	8	3	....	....	....
130	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	100	86	73	62	52	43	35	28	21	15	10	5	2	....	....
125	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	100	86	73	61	51	41	33	26	19	13	8	4	....	....

Temperature Control Apparatus

Equipment is available that will automatically control the dry bulb temperature and humidity and thus overcome any danger of spoiling the fruit through neglect of the operator. If this equipment cannot be purchased, a recording hygrometer will keep a very good check on the temperature and humidity.



Tycos recording hygrometer with cistern feed water system.

Dehydration Equipment

Besides the actual mechanism for dehydrating fruit or vegetables, there are many other pieces of machinery and features of the plant to be considered. In Canada at the present time the primary interest is in the dehydration of apples, prunes, apricots, and loganberries. The equipment needed for the preparation of these fruits varies and may be listed as follows:—

Apples.—Peelers, corers, seed cellers and slicers.

Prunes.—Lye dipper, washer and trayer.

Apricots.—Hand labour is needed to pit the fruit and spread it on trays.

Loganberries.—No preparation is needed.

Trays and Cars.—The trays on which the fruit is placed are illustrated in figure 1. Trays have been made of tinned one-quarter inch hardware cloth, galvanized hardware cloth, and of narrow wooden strips. The latter have proven themselves to be the best as they do not contaminate the fruit with metallic salts and do not sag in the centre.

The cars as illustrated in figure 2 are for conveying trays and fruit from the preparation room and through the dehydrator.

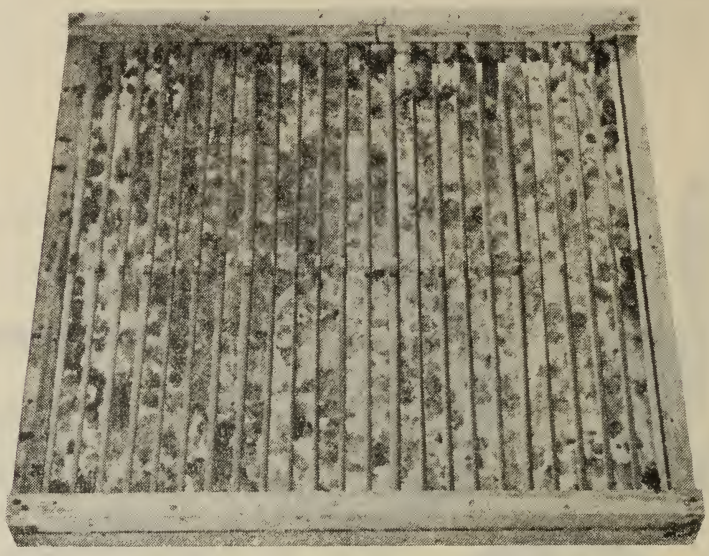


FIG. 1.—A very satisfactory wooden tray. (Courtesy Miller Dehydrator Co., Eugene, Oregon.)

FIG. 2.—A tunnel car of the Miller type. Note the grooved wheels for following tunnel tracks. (Courtesy Miller Dehydrator Co., Eugene, Oregon.)

Plant Arrangement

As far as possible it is wise to arrange the plant so that the fruit progresses step by step without doubling back. The preparation room is located at the end of the drier where the fruit is admitted, while curing bins are located at the end of the dehydrator where the fruit is removed. With this arrangement all operations are done systematically and do not conflict with one another. The curing bins are sometimes located on different floors from the main plant. This practice is most satisfactory in the case of dehydrated apples.

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