DEHYDRATION

OF

FRUITS AND VEGETABLES IN CANADA

A SUMMARY OF FOUR YEARS WORK OF THE DEHYDRATION COMMITTEE, DEPARTMENT OF AGRICULTURE, OTTAWA

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DEHYDRATION OF FRUITS AND VEGETABLES IN CANADA

INTRODUCTION

For years great quantities of foreign fruits have been imported into Canada. At the same time, although thousands of tons of good Canadian fruit either went to waste in the orchard or brought so small a price to the producer as to make it unprofitable for shipping, a very considerable portion of the Canadian public were without an adequate supply of fruit of any kind.

The general channels of distribution for fruits are as follows: Fresh fruit, canned fruit, preserves, jam, jellies, etc., and dried fruit.

The fresh fruit industry and the canned fruit, jams, jellies, etc., industry has been showing a gradual increase year by year, but the dried fruit industry in Canada has shown a decline in both production and distribution of the Canadian product, although there has been a decided increase in the importation of dried fruit.

Possibly as a basis for summarizing the situation, it might be well for us to consider, in a general way, the fruit industry in Canada. The following figures, though not exhaustive, will throw light on the dehydration and evaporation problems in relationship to the present and future of these industries.

The following tables show the figures for Canadian imports and exports of fruit for the year ending March 31, 1926.

IMPORTS

Fresh Fruits

Apples	barrels	150,840	$ 800,059
Apricots, quince, etc.	lb.	1,958,171	139,289
Cherries	lb.	501,051	81,071
Cranberries	barrels	20,758	205,204
Grapefruit	lb.	18,655,220	924,558
Grapes	lb.	12,565,121	826,531
Lemons	boxes	345,677	1,345,575
Oranges	boxes	1,729,555	7,406,484
Peaches	boxes	14,898,566	645,001
Pears	boxes	20,905,150	926,398
Pineapple	boxes	......	520,169
Plums	bush.	190,754	495,035
Strawberries	lb.	3,168,975	607,345
All other fruits, fresh		......	2,782,559
Total value of fresh fruit imported			$17,705,278

Fruits, Dried

Apples	lb.	1,174,553	$ 35,144
Apricots	lb.	989,664	150,634
Currants	lb.	4,889,109	334,263
Dates	lb.	11,727,978	792,204
Figs	lb.	4,694,301	418,504
Peaches	lb.	1,621,878	171,216
Prunes	lb.	14,776,062	1,109,827
Raisins	lb.	33,811,732	2,325,285
Other fruits, dried		......	84,691
Total value of imports, dried			$ 5,421,768

Fruits, Canned or Preserved

Citron, lemon and orange peel	$ 49,342
Peaches	338,143
Pineapple	642,355
Other fruits	545,990
Jams and jellies	332,615
Total value of imports, canned, etc.	$ 1,908,445

EXPORTS

Fruits, Fresh

Apples	barrels	1,388,493	$ 6,856,916
Berries of all kinds		......	497,472
All other fruits		......	109,258
Total value of fresh fruit exported			$ 7,463,646

Fruits, Dried

Apples	lb.	4,399,926	$ 456,508
Other fruit	lb.	10,100	2,382
Total value of dried fruits exported			$ 458,890

Fruits, Canned

Total value exported from Canada	$ 658,097

These figures, which are fairly representative of the average of recent years, show that there is a tremendous amount of money being sent out of Canada for fresh and dried fruits notwithstanding the fact that a large proportion of similar, or equally as good, fruits might well be produced in Canada in areas essentially fitted for such production.

To investigate the cause of this and to see what remedy might be applied was the reason for appointing a special committee known as the "Dehydration Committee."

PERSONNEL OF THE COMMITTEE

E. S. Archibald, B.A., B.S.A., Director of Experimental Farms, *Chairman.*
Geo. E. McIntosh. Dominion Fruit Commissioner, *Vice-chairman.*
F. T. Shutt, M.A., D.Sc., F.I.C.. Dominion Chemist.
W. T. Macoun, Dominion Horticulturist.
C. S. McGillivray, Chief Canning Inspector, Health of Animals Branch, *Secretary.*

The committee was appointed in May, 1923. The members immediately began to gather information from various sources and in June the secretary was sent to Washington, Oregon, and California to study the methods in use in those states. He visited a number of the plants and before leaving California he secured the services of a graduate from the University of California to advise and assist in the establishment of the first experimental plant. He also secured a complete dehydration plant, which was shipped to British Columbia.

OBJECT OF INVESTIGATIONS

(1) To ascertain if Canadian fruits will dehydrate.

(2) To ascertain whether or not they will make a better product than the ordinary evaporated fruits.

(3) To ascertain if Canadian dehydrated fruits compare favourably with similar fruit products of other countries.

(4) To ascertain what kinds of fruits are most suitable for dehydration.

(5) To ascertain what types of machines are best suited for our requirements and what methods of preparation should be followed.

(6) To ascertain if Canadian dehydrated fruits can be put on the market at a price sufficient to give a profit to the fruit-grower and to the manufacturer.

(7) To ascertain if dehydration will take care of the unprofitable surplus of the fresh fruit market production.

To carry out these investigations three types of plants were installed, viz: a laboratory plant at Ottawa, a semi-commercial plant of the cabinet type at Penticton, B.C., and a small commercial tunnel plant at Grimsby, Ont.

Ottawa Laboratory Plant

The laboratory plant at Ottawa is for special test work only. It is very complete and has been a means of obtaining much information.

THE PENTICTON DEHYDRATOR

This is a cabinet, three-section plant which was purchased in California. It can be considered as a semi-commercial and semi-laboratory type only. The building and the dehydrated product were destroyed in a fire in 1923, but the dehydrator itself was saved. However, a few facts from the 1923 work were obtained and were corroborated in succeeding years.

The Penticton plant was operated in 1923, 1924, and 1926. Nothing was done in 1925 on account of the fruit crop failure. Some of the outstanding facts obtained from the work at this dehydrator relative to varieties, yields, maturity of fruit, size of fruit in relationship to the quantity, quality, and cost of the dehydrated product will be recorded on succeeding pages.

The Grimsby Dehydrator

This is a two-tunnel, commercial type dehydrator. It was established in a building too small to give the necessary accommodation for the proper preparation of the fruit, the curing of the fruit after dehydration, and space for storing and packing. Moreover, owing to the limited amount of space, the commercial labour-saving devices, such as automatic carriers, power slicers, etc., were not installed, hence the plant could scarcely be considered commercial. Nevertheless the dehydrator is of a sufficiently commercial type to give relative yields, etc.

This plant at Grimsby was operated in 1923, 1924, and 1925. Nothing was done in 1926 as it was felt that efforts should be concentrated in the Okanagan valley, where problems were most acute.

Facts which have been brought out from the work of this plant relative to quality, varieties, yields, frozen apples, dehydrated potatoes, cost studies, etc., will be dealt with further on in this report.

THE PRINCIPLE OF DEHYDRATION

There are three methods of drying fruits commercially—sun-drying, evaporation, and dehydration.

Sun-drying is particularly practised in hot, dry climates where there is little or no precipitation.

Various systems of evaporating fruit and vegetables have been used with more or less success.

Experimental work in dehydration has been carried on for years in many countries, but until recently the cost of production has been so great as to make it impracticable.

However, during the past ten years new systems have been devised and such improvements have been made that to-day better and cheaper fruit can be produced by dehydration than can be produced by either sun-drying or evaporation.

Let us suppose we have a ton of sound winter apples 2½ inches in diameter. When this ton of apples is peeled and trimmed there will be approximately 1,424 pounds of edible fresh apples, and 576 pounds of skins, cores and trimmings. When the 1,424 pounds of edible apples are properly dried there will be 237 pounds of finished product (see Ck. No. 23, table No. 2, page ·).

If we take the weight of the finished product, 237 pounds, from the weight of the edible product, 1,424 pounds, we find the weight lost in drying. In other words 1,187 pounds of water have been evaporated from the ton of fresh apples after the skins, cores and trimmings have been removed. Our problem is to determine the best method to convert this 1,187 pounds of water into vapour and distribute it through the air.

Air, at normal temperature, will absorb this moisture but the process is very slow. As the air is heated the rate of absorption increases.

Actual experiments show us that the amount of moisture which a given volume of air can absorb before it reaches the saturation point is practically doubled with every 27 degrees increase of temperature, that is to say, the air will absorb twice as much moisture on a day when the thermometer registers 92° as it will on a day when it registers 65°. But the saturated air must be replaced by dry air, otherwise, when the adjacent air becomes saturated, evaporation will cease. To overcome this artificial methods are used to produce air flow and thus provide a constant supply of fresh dry air.

If the 1,187 pounds of water was in free, liquid form it would be quite a simple matter to increase the heat to 212 degrees, when the water would be converted into steam. But the water is not in free, liquid form. It is in the cells of the fruit and must be brought out of those cells before it can be evaporated, as evaporation takes place only on the surface.

If the air used in drying fruits or vegetables is allowed to escape into the atmosphere, after passing through the dehydrator, a large amount of heat is lost. If on the other hand the air is returned to the heating chamber and used again this heat is conserved. This principle is employed in dehydration.

Certain fruits case-harden, i.e. become overdried on the surface, and drying is retarded. This condition may be avoided by increasing the relative humidity of the drying air, and is accomplished in most dehydrators by providing for recirculation of a portion or all of the air used in drying.

This principle is well illustrated by the Ottawa Experimental dehydrator shown in figure 1.

OPERATING THE DEHYDRATOR

Ottawa Dehydrator

Fig. 1 gives a front view of this plant. The fruit is prepared in the usual way and spread on trays. The heaters are located in the back tunnel. The fan, shown at left end of the tunnel, draws the heated air from the back tunnel and drives it through, and over, the trays of fruit placed in the front tunnel. When the air passes through the front tunnel it returns to the back tunnel to complete this circuit.

Figure 2 gives a side view of the plant with the trays exposed. Arrangements are made at the right end of the tunnel fig. 2-C for the outlet of a portion of the moisture-laden air, and this portion is replaced through an opening shown on the top of the tunnel near the right hand end immediately ahead of the heater, fig. 2D.

By this arrangement it may be seen that a constant current of heated air is being passed over the fruit and as the moisture-laden air is permitted to escape, fresh, dry air from outside is taken in to replace it.

Suppose that all the used air had been taken in at point D (fig. 2) drawn over the heater A by fan B, then forced through the front tunnel containing the trays of fruit and allowed to escape through the opening provided in fig. 2-C. In this instance the air is pre-heated, used once and allowed to escape. This process would be an example of evaporation.

On the other hand, suppose the air is taken in at opening D, fig. 2, drawn over the heaters by fan B, forced over the fruit in the tunnel and only a small portion of the moisture-laden air allowed to escape through opening C, fig. 2, the balance being taken around the curve into the back tunnel where it is mixed with a quantity of fresh air taken in at opening D, equal to the amount discharged at C.

This process would illustrate the first step in dehydration. This is what is known as the re-circulating system.

If we apply this to the experimental plant above we find the following conditions will result.

The fruit is loaded on the trays and placed in the tunnel. The fan is started and the heated air is driven over the fruit where it absorbs moisture

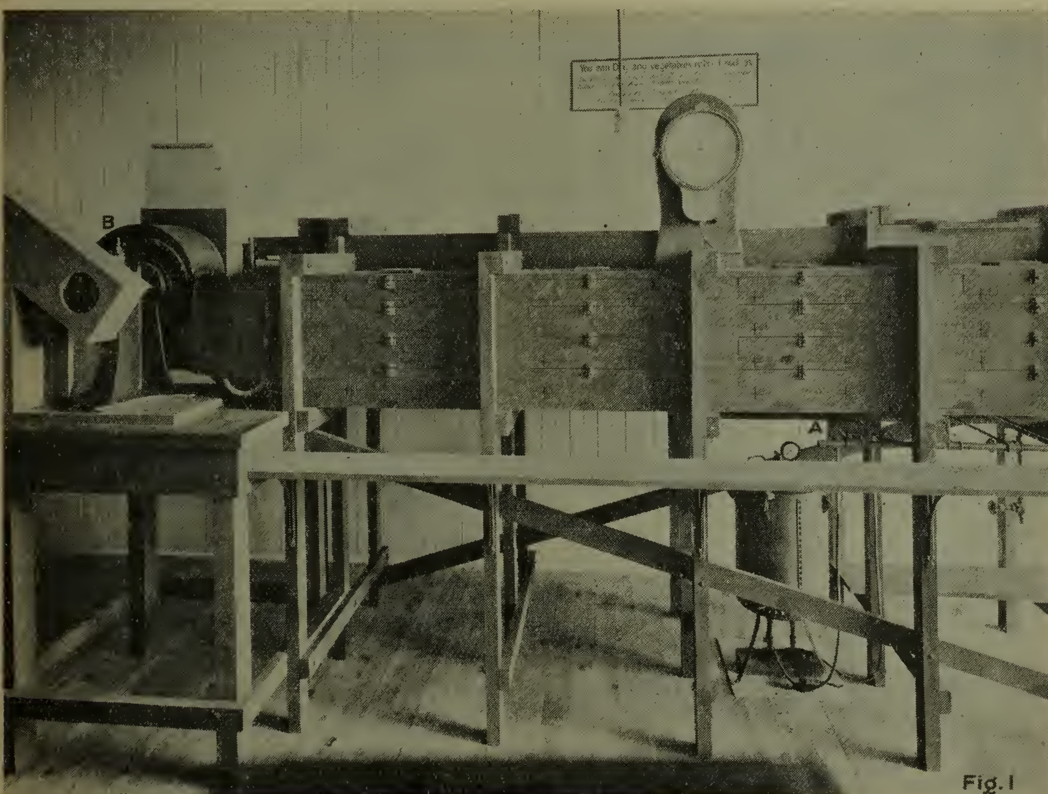

Fig. 1.—Front view of Experimental dehydrator at Ottawa. A. Shows the location of the heater in the back tunnel. B. Shows the fan which supplies the current of air.

from the surface. When the air has reached point C, fig. 2, it is heavily saturated with moisture. The dry-bulb reading will probably be 160 degrees F, while the wet-bulb reading will be about 120 degrees F.

If we open the slide at C, fig. 2, we can let out some of the moisture saturated air and replace it by dry air from opening D, fig. 2.

The dry and the wet bulbs should be placed in the back tunnel between the heaters and the fan. It will thus be seen that it is an easy matter to govern the initial humidity by opening or closing the slide C, fig. 2. It must be borne in mind, however, that the degree of humidity does not remain constant, for, as the fruit dries the degree of humidity becomes less and at the finish it will be not more than 5 to 10 degrees. This change of humidity follows what is known as a "curve". This curve has been scientifically worked out for both temperature and humidity readings.

The fruit is examined from time to time (see tray drawn in fig. 2) and when it is dried sufficiently it is taken from the tunnel and stored for curing.

Dehydration is, therefore, a system of drying fruits, etc., using temperature, humidity and air velocity control.

Let us examine what would result should any of these three requirements not be under control.

(1) If the temperature is too low, drying is retarded. If too high, the outside of the fruit becomes case-hardened and the fruit burns.

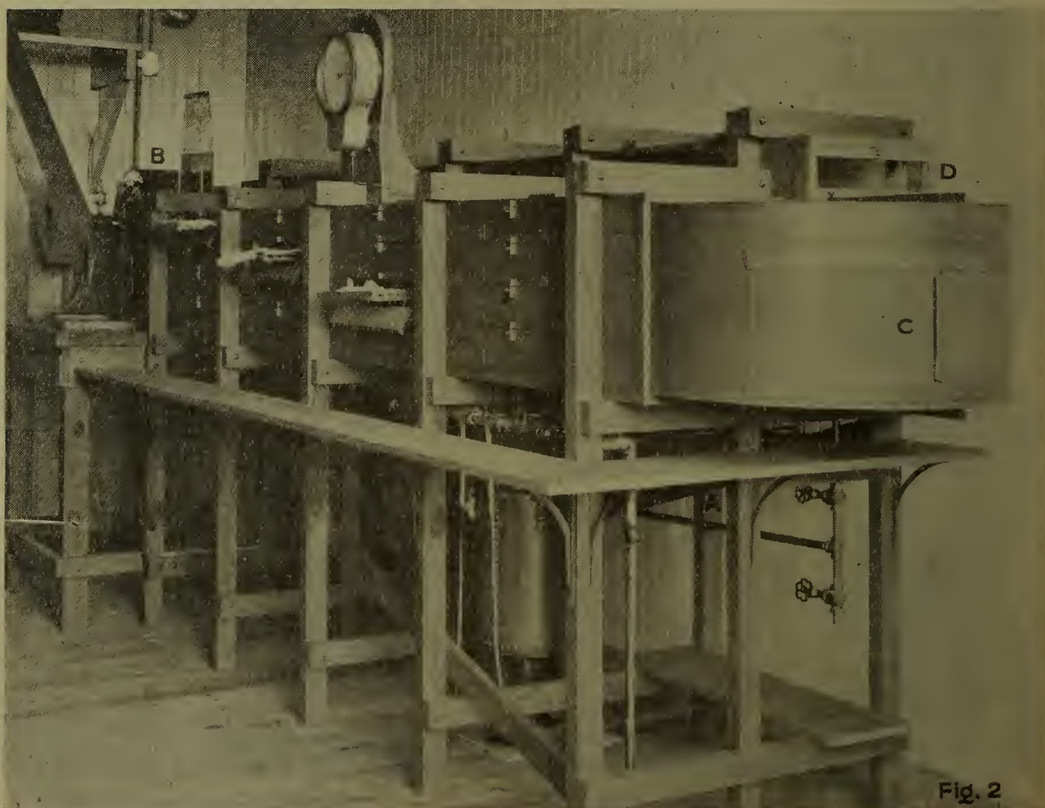

FIG. 2.—Side and end view of experimental dehydrator, Ottawa. A and B. Shewn same as in Fig. 1. C. Shows the air outlet control. The outlet is closed in this photograph but opens where the line is shown. D. Shows the air inlet control. It is open in the photo.

(2) If the humidity is too low, the fruit is not drying; if it is too high the air is filled with moisture above the saturation point and becomes steam, resulting in a cooked product.

(3) If the air velocity is too slow, drying is retarded and cooking and discoloration are apt to follow. If the air velocity is too fast, heat and power are wasted.

The foregoing temperatures are those which were found best adapted for apples but they do not apply to all fruits and vegetables. Some fruits require a much lower temperature and humidity.

The Penticton Dehydrator

Fig. 3 gives a view of this plant with the side doors removed and the tunnels exposed. This plant is what is known as the cross-current type. Fig. 4 gives a view of the workers preparing peaches by splitting, trimming and removing the pits. Fig. 5 shows the method of filling the trays with the raw peaches. Fig. 6 is a diagram of the dehydrator.

The peaches are split, pitted and trimmed as shown in fig. 4, they are then placed on trays as shown in fig. 5, and loaded on a truck as shown at the left side of fig. 3. This truck, loaded with trays of peaches, is put in the bleaching tunnel outside the work room, and when the fruit is sufficiently sulphured it is brought to the drying tunnel shown in fig. 3.

The trays are removed from the truck and placed in the drying tunnel. They rest on the projections which form the air ducts shown in fig. 6. When the trays are in the tunnel the doors are closed and drying operations are ready to commence.

Fig. 3.—View of Penticton cross current, semi-commercial dehydrator with doors removed to give view of drying chamber.

The air is heated by the coils as shown in fig. 6. The heated air, driven between the coils, travels by way of the air ducts through the opening in one side of the tunnel, passes over the fruit and through the air ducts on the opposite side of the drying-chamber, thence back to the fan by the return air duct. This completes the circuit.

The details of the system of air flow are shown in fig. 6. Between each drying-chamber is an air duct and in this air duct is a damper. Reference to the drawing will show four air ducts for three drying-chambers. This arrangement is intended to provide a reversible air flow. In the drawing, the top of the damper is thrown to the right, the bottom to the left, equally dividing the air ducts into A1, A2, B1, B2, C1, C2, D1, D2. It can be seen that if the air ducts should be left open the warm air would circulate without coming into

Fig. 4.—Workers preparing peaches for Penticton dehydrator.

Fig. 5.—Placing peaches on trays for Penticton dehydrator.

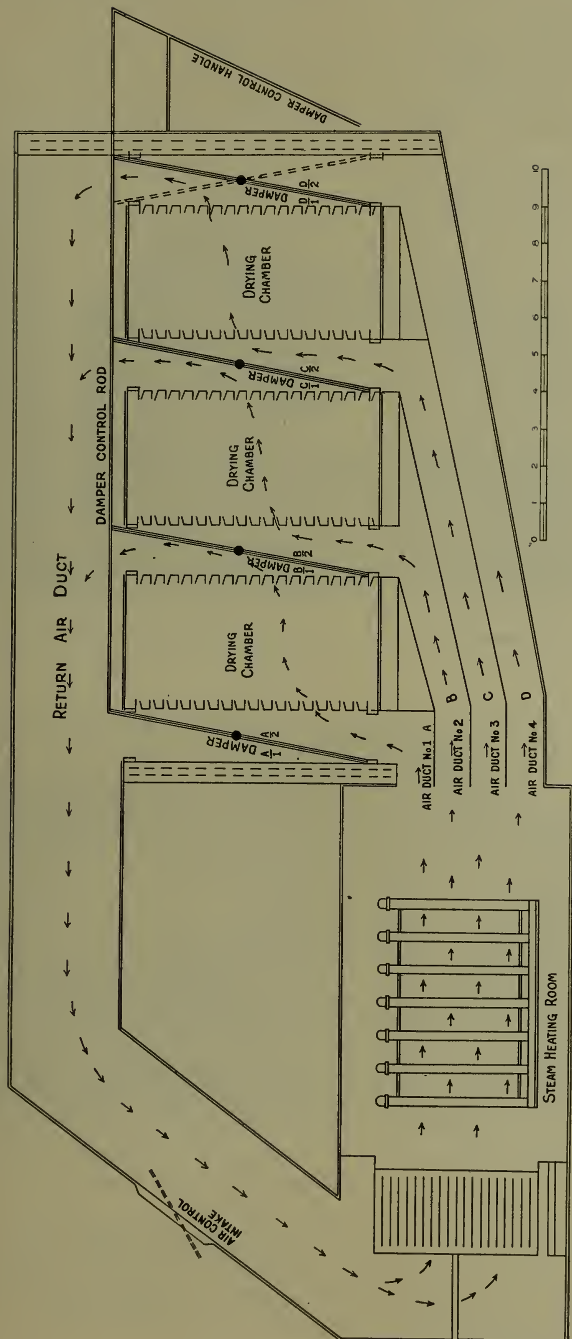
DAMPER CONTROL HANDLE
DRYING CHAMBER
DRYING CHAMBER
DRYING CHAMBER
DAMPER CONTROL ROD
RETURN AIR DUCT
DAMPER
DAMPER
DAMPER
DAMPER
A
B
C
D
AIR DUCT No 1
AIR DUCT No 2
AIR DUCT No 3
AIR DUCT No 4
STEAM HEATING ROOM
AIR CONTROL INTAKE

Fig. 6

contact with the fruit. It becomes necessary, therefore, to stop this free air flow and direct it over the fruit. The dampers accomplish this diversion of air flow. They swing from their centre and the three are controlled by a lever as shown in the drawing.

The drawing shows four air ducts No. 1, 2, 3, and 4. The dampers as shown are set so that the warm air flow travels via ducts No. 1, No. 2, No. 3 and thence through the opening provided on the sides of the drying chambers. It passes over the trays of fruit and makes its escape from the drying chamber through the openings on the opposite side into the air ducts B1, C1, and D1 and thence by return air duct to the fan. With the damper set in this position it will be seen that air duct No. 4 is not in use, and might have been closed at the front.

However, after the drying has been carried on for a couple of hours it is often found desirable to reverse the air flow. To do this the damper control handle is drawn out, thus forcing the dampers to the opposite side of the air duct (see dotted lines). This causes the air to flow through B1, C1, D1, over the fruit and out through A2, B2, C2, and in this case air duct No. 1 is not in use.

The air as it passes between the steam coils is dry and warm. As it passes over the fruit it absorbs moisture. The saturated air returns by way of the return air duct and provision is made so that when it passes down this duct before reaching the fan it passes the air control intake.

This air control intake is in the form of a trap-door hung on a swivel. The top tilts inwards diverting the air to the outside, the bottom tilts outwards permitting an equal amount of dry air from outside to enter the tunnel and mix with such portion of moist air as may not have been allowed to escape from the outlet.

The humidity of the air passing through the fan is governed by this opening. The greater the amount of saturated air let out the less the humidity of the mixed air drawn through the fan.

The fruit on the trays is examined from time to time and when it is found dry enough the trays are removed, allowed to cool, and the dried product emptied into piles to cure.

The Grimsby Plant

This plant is of the tunnel type. It consists of two tunnels side by side. The heating chamber in this plant is underneath the tunnels.

Fig. 7 shows a view of the building in which the plant is located, while fig. 8 gives a side and end view showing the sulphur-room on the platform.

The building is of galvanized iron construction. The tunnels are built in the building against one side of it. They are 6 feet high, 4 feet wide and 48 feet long. The two tunnels are side by side and are built on the heating tunnel which is 4 feet high, 8 feet wide and 36 feet long. At each end of the tunnel is an ante-chamber 6 feet long. From this ante-chamber doors open into the drying-chamber. At each end of the drying-chamber are openings through the floor 4 feet square. They are covered with wire grating. The openings are provided to permit the flow of air from the fan through the drying-tunnel and return through the heating-tunnel below.

Fig. 9 is a diagram showing the drying and heating chambers in the Grimsby plant.

The fruit is prepared, spread on trays and loaded on trucks. The loaded trucks are run into the sulphur-room where the fruit is sulphured. When the fruit is sufficiently sulphured the truck loaded with fruit is removed from the sulphur-room to the end of the tunnel farthest away from the fan at X.

The air is heated in the heating-tunnel by passing between steam coils. It is drawn through the fan and driven upward, through the drying tunnel at C. It passes through the openings between the trays and travels over the fruit to the opposite end of the tunnel at D as shown in fig. 9. When the air has reached

Fig. 7.—Front and side view of Grimsby dehydrator. Galvanized-iron construction.

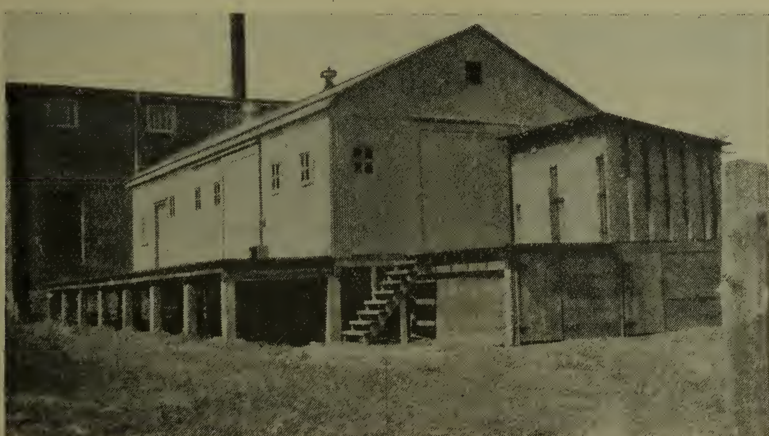

Fig. 8.—Side and end view of Grimsby dehydrator showing sulphur-house on back platform.

the other end of the drying-tunnel it is heavily saturated with moisture. Part of this moisture-saturated air is allowed to escape at the outlet shown in fig. 9, while fresh dry air is admitted to replace the moist air at the fresh-air inlet shown in fig. 9. Proper control of these two openings governs the humidity of the air in the drier.

As succeeding truck loads of trays of fresh fruit are ready for the drying-tunnel, those truck loads which are already in the tunnel are moved forward to provide space for others.

Fig. 10 shows the drying-tunnel filled with six truck loads of trays of fruit. In their progress towards the left-hand end (fig. 9, C) the trays of fruit have become drier and the temperature in that portion of the tunnel is higher. When the fruit is dry enough, the truck is taken from the left-hand end of the tunnel at Y into the ante-chamber and thence into the cooling-rooms. The fruit is allowed to cool, the trays are emptied and the fruit is placed in piles to cure.

This is what is termed a progressive drying system. To illustrate, we will suppose it takes eight hours to dehydrate a truck load of fruit. This would mean that eight hours from the time the truck load of apples entered the tunnel at X it should be ready to leave at Y and in the meantime it had been moved forward the length of a truck six different times to make room for fresh truck loads to replace those which had gone out dry.

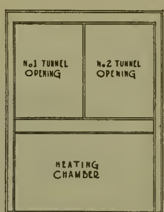

FIG. 11.

FIG. 13.

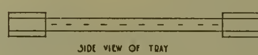

FIG. 12.

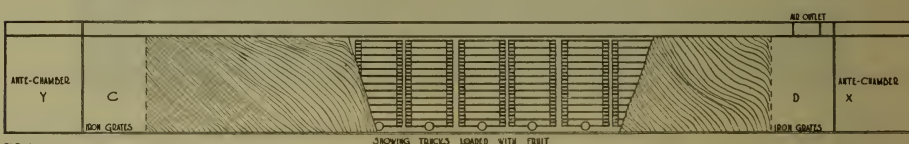

FIG. 10.

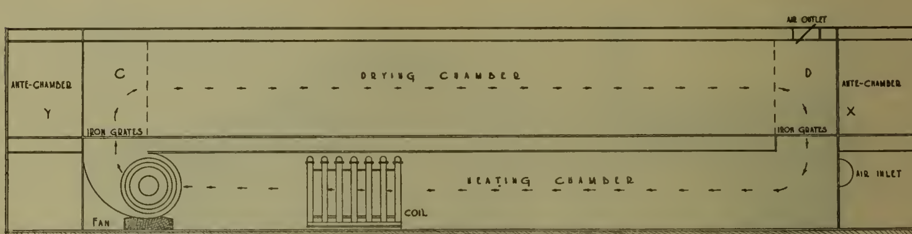

FIG. 9.

Suppose apples were to be dried; the air should be heated to about 165°F. at Y and 140°F. at X. This would provide the proper humidity. The fan should deliver enough air draft to keep that temperature and humidity constant.

Fig. 11 shows a front view of the tunnel opening. Fig. 12 shows side view of tray. Fig. 13 shows end view of the tunnel.

ARRANGEMENT OF HEATING SYSTEMS IN TUNNEL PLANT

The tunnel type is the system generally in use. The arrangement of the tunnels differs. Some prefer to have the hot-air chamber over the drying-chamber. Others provide for a heating-chamber between the two tunnels.

This, however, is a matter of detail and can best be worked out for the convenience of the operator.

The general principle is the same regardless of the arrangement of the tunnel.

It is our experience that the tunnel type dehydrator is best adapted for commercial work.

KIND OF TUNNEL RECOMMENDED

The Grimsby dehydrator tunnels are constructed of wood, but we would not recommend wooden construction as the joints soon open, resulting in loss of heat. The most satisfactory construction we have seen is hollow tile and iron doors.

PREPARATION OF FRUITS AND VEGETABLES FOR DEHYDRATION

There are differences in the manner of preparation of various fruits and vegetables. Apples are peeled, trimmed, and sliced. Peaches are split and pitted. They may or may not be peeled. Pears are halved and cored. They may or may not be peeled. Apricots are halved and pitted. All are sulphured before drying. Prunes and plums are dipped in a lye solution to cut the bloom on the surface and permit evaporation. Berries require no previous preparation before drying. Beans, corn, and peas are better blanched before drying, while potatoes require sulphuring.

The following kinds of fruit and vegetables have been dried: apples, apricots, berries, cherries, crabapples, grapes, peaches, pears, plums, prunes, beans, carrots, potatoes, pumpkin, squash, spinach, turnips.

DEHYDRATION OF FRUITS AND VEGETABLES

Apples

Apples dehydrate very successfully. The cost of peeling, trimming, and slicing fruit for dehydration is the same as for evaporated fruit. The fuel cost for dehydration is only about 35 per cent to 50 per cent of the fuel cost for evaporation. The dehydrated product retains its flavour and texture and will rehydrate to 98 per cent to 99 per cent of its original weight. The quality of the finished product will depend to a large extent upon the quality of the raw product going into the manufacture of the same. A table of comparative yields of apples is shown on page .... This table gives the data gathered from the examination of twenty-one samples of apples, each of a quantity sufficient to produce one ton of dried stock. It will be noted that, generally speaking, it takes more culls than orchard run to produce the same quantity of finished product, but this is not always the case. For example, Lot No. 189, culls, and Lot No. 205, orchard run, took exactly the same weight. The explanation of this is that the culls were of good quality while the orchard run was small and crooked.

Some varieties of apples require more fresh fruit to produce a given amount than do others.

Also, apples of the same variety vary in weight in proportion as they vary in maturity. Lot No. 220 required 16,400 pounds to make a ton of dry stock, while Lot 233 required 4,000 pounds less. These two lots were off the same trees and were picked ten days apart. Lot 220 was picked for fresh fruit shipping. Lot 233 was picked when the orchard was being cleaned up.

Table No. 2 gives details from actual testing concerning one ton of fresh apples of the different sizes, grades, and varieties.

The first column shows the test check number. The second the size of the apples. The third shows the number of apples in one ton of fresh apples. This count has been carefully checked through at least five tests to each size.

The third column gives the grade of apples used, whether culls or hand-picked stock. The fourth column shows the variety of apples used, whether mixed or of one variety. The sixth column shows the percentage of waste. The eighth column shows the time required to peel and trim the apples in one ton, while the next column shows the cost for peeling and trimming the same. The tenth column shows the quality of apples produced, the eleventh shows the weight of dehydrated apples obtained, while the last one shows the value of same at current market prices.

It should be noted that the prices given are for labour at peeling, coring, and trimming, while the selling price is the price which the packer gets from the wholesaler.

The cost of apples, fuel, boxes, labour (other than peeling and trimming), freight, and overhead are not included.

This table shows very plainly that the product of some sizes of apples does not sell for enough to pay for peeling, coring, etc., let alone to pay for fruit and labour and other necessary costs.

TABLE No. 1—PARTICULARS CONCERNING THE QUANTITY OF FRESH APPLES REQUIRED TO PRODUCE 1 TON DRIED STOCK

Lot No.	Variety		Per cent waste	Pounds required
189	McIntosh	Culls	35	17,400
195	McIntosh	Culls	37	20,400
199	McIntosh	O.R.	25	16,800
203	McIntosh	O.R.	26	14,400
205	McIntosh	O.R.	29	17,400
208	McIntosh	Culls	36	21,200
212	McIntosh	O.R.	27	15,200
237	McIntosh	O.R.	27	18,000
190	Johnathan	Culls	38	25,400
196	Johnathan	Culls	36	16,800
222	Johnathan	Culls	34	16,300
223	Johnathan	O.R.	48	23,400
231	Johnathan	O.R.	31	16,000
204	Cox Orange	O.R.	31	16,000
217	Wealthy	O.R.	31	15,000
325	Baldwins	Culls	44	20,800
220	Grimes Golden	O.R.	28	16,400
233	Grimes Golden	O.R.	31	12,400
229	Yellow Newton	O.R.	28	14,200
234	Yellow Newton	O.R.	31	13,600
236	Rome Beauty	O.R.	27	19,800

TABLE 2—SHOWING RESULTS OF EXAMINATION OF ONE TON OF FRESH APPLES, EACH OF VARIOUS SIZES AND GRADES

Ck. No.	Size	Number of apples in ton	Grade of apples used	Variety of apples used	Raw stock obtained	Per cent waste	Time to peel and trim	Cost to peel and trim	Quality obtained	Lb. obtained	Selling price
					lb.	p.c.	min.	$ c.		lb.	$ c.
12	1½	42,160	H.P....	Mixed....	840	58	1,506	12 55	Seconds..	140	11 20
3	1¾	26,890	H.P....	Mixed....	974	52	960	8 00	Seconds..	162	12 96
6	1¾	26,165	Culls...	Mixed....	614	70	934	7 78	Seconds..	102	8 16
11	2	17,039	Culls...	Mixed....	874	57	608	5 06	Seconds..	146	11 68
13	2	17,149	H.P....	Mixed....	1,080	46	612	5 10	Standard.	180	18 00
15	2	15,268	H.P....	Ben Davis	1,186	41	545	4 54	Standard.	198	19 80
22	2	15,818	H.P....	Mixed....	1,110	45	565	4 71	Standard.	185	18 50
1	2¼	12,608	Culls...	Mixed....	1,236	40	450	3 75	Standard.	206	20 60
10	2¼	13,502	Culls...	Mixed....	880	56	482	4 01	Standard.	147	14 70
14	2¼	13,013	H.P....	Ben Davis	1,220	39	465	3 87	Choice...	203	24 36
16	2¼	13,468	H.P....	Stark....	1,260	37	481	4 01	Choice...	215	25 80
21	2¼	12,982	H.P....	Baldwin..	1,190	41	463	3 86	Choice...	198	23 76
2	2½	8,888	H.P....	Greening.	1,360	32	317	2 64	Choice...	227	27 24
5	2½	8,913	Culls...	Mixed....	1,000	50	318	2 65	Standard.	166	16 60
17	2½	8,719	H.P....	Stark....	1,370	31·5	311	2 59	Choice...	228	27 36
23	2½	9,267	H.P....	Baldwin..	1,424	29	331	2 76	Fancy....	237	35 55
24	2½	8,767	H.P....	Ben Davis	1,380	31	313	2 61	Fancy....	230	34 50
29	2½	8,602	H.P....	Cranberry	1,358	32	307	2 56	Fancy....	226	33 90
4	2¾	7,692	H.P....	Mixed....	1,340	33	275	2 29	Standard.	223	22 30
9	2¾	7,261	Culls...	Mixed....	1,068	47	260	2 17	Standard.	178	17 80
18	2¾	6,765	H.P....	Cranberry	1,444	28	242	2 02	Fancy....	241	36 15
19	2¾	6,625	H.P....	Baldwin..	1,464	27	237	1 97	Fancy....	244	36 60
20	2¾	6,022	H.P....	Ben Davis	1,520	24	215	1 79	Fancy....	253	37 95
30	2¾	6,972	H.P....	Stark....	1,440	28	249	1 63	Fancy....	240	36 00
7	3	6,004	H.P....	Mixed....	1,440	28	215	1 79	Standard.	240	24 00
25	3	5,470	H.P....	Baxter....	1,516	24·2	196	1 62	Choice...	253	30 36
26	3	5,448	H.P....	Ben Davis	1,524	24	195	1 62	Choice...	237	28 44
28	3	5,745	H.P....	Cranberry	1,500	25	205	1 71	Choice...	250	30 00
8	3¼	5,118	H.P....	Baxter....	1,490	25·5	183	1 52	Choice...	248	29 76
27	3½	4,776	H.P....	Baxter....	1,620	19	170	1 42	Choice...	270	32 40

Referring again to table 2, column 3 shows the difference in count in one ton of apples of the same size but of different varieties.

Column 6 shows difference in yield of various lots of apples of the same, or different sizes, varieties and grades.

The tenth and eleventh column give a good illustration of the quality and quantity of finished stock which can be expected from the various grades of raw material.

A great many Canadian packers are complaining that, though they buy their apples very cheaply, they are steadily losing money on their evaporated apple business.

If they study the foregoing tables they can readily see what they may expect to make out of the stock they buy when they consider manufacturing costs, quality produced, prices obtained and returns from sales.

Apricots

The experimental work on apricots was not as complete as desired. It was not possible to get orchard control on this product, owing to circumstances which made it impossible to operate the plant at the time the fruit was ready to be picked. The experiments have been made, to a great extent, on stock held in cold storage for one or more weeks, or from packing-house culls. Blenheim, Moorpark, Montagamet, Royal, Tilton and Russian varieties were tested. The sound ripe product of each variety was good and merchantable. The product of green or over-ripe fruit was worthless. The drying ratio of the good fruit averaged from 6.6—1 to 8.6—1.

Tests on a couple of the varieties showed that the large ripe fruit yielded in the proportion to 6.6 to 1, smaller fruits of same variety in equally good condition required 8.6 to 1 while fruit which was green, but considered ripe enough for fresh fruit shipment, required as high as 14.7 to 1. It is needless to say the last sample was worthless.

The size of the pits in apricots varies, to a considerable extent, according to the variety, but the size of pits in the same variety varies very little, regardless of the size of the fruit. The wastage in pits is in ratio to the count per pound.

This is one of the varieties of fruit which we believe should be further tested. There are very large plantings of apricots coming into bearing in British Columbia, the fruit of which should make a dried product equal to any on the market.

Berries

Grouped under this heading are, blackberries, blueberries, gooseberries, loganberries, raspberries and strawberries.

Blackberries

Blackberries dehydrate to a very nice product. The fruit remains practically whole and, when rehydrated, comes back to very nice appearance and flavour.

Blueberries

The dehydration of blueberries was an innovation and the Dominion Horticulturist reports that the results were remarkably good, the product refreshing exceptionally well, and the quality of pies made therefrom being excellent. Further experimental work is required in this, as there seems to be some future to blueberry dehydration in supplementing, at least, the frozen blueberry trade which is growing so rapidly.

Crab Apples

Excellent results were obtained from the experiments with crab apples. The drying ratio was about 6 to 1, that is, it took 6 pounds of fresh crab apples to make 1 pound of dehydrated crab apples.

A ton of ripe crab apples was purchased on September 8, 1924. One hundred pounds were taken for jelly-making and the balance used for dehydration. On the day the fruit was received duplicate samples of 6 pounds of fresh crab apples were taken and made into jelly. The yield was 7 jars each, the balance of the 100 pounds of fresh fruit was put aside for one week when other duplicate 6 pound samples were taken from the lot and made into jelly. The yield was 5 jars each. A week from that date other duplicate samples were taken when the yield was 3 jars each. A week later further duplicate samples were taken but the juice would not set, resulting in no jelly.

The equivalent in dehydrated crab apples of the 6 pounds of fresh crab apples, viz., 1 pound, was taken at the same time and the resultant yield was 7 jars. The quantity, appearance and flavour of the jelly made from the dehydrated stock was in every way equal to that made from the fresh stock on the day it was received. It was of better colour and flavour and two and one-third times as much in quantity of the jelly made from fruit two weeks old.

These figures are quite significant when one considers that crab apples seldom reach the retailer within a week from the time they are picked, indeed, in very many cases they are still in the retailers hands two and three weeks after picking.

Three tests of dehydrated crab apples made in February, 1927, from crab apples packed in September, 1924, showed the same yield as came from the freshly picked crab apples in September, 1924.

Gooseberries

Gooseberries, too, will dehydrate, but we are not very much impressed with the product obtained.

Loganberries

Loganberries dehydrate into a delightful product. The colour, flavour and appearance is well preserved. When rehydrated they are almost as natural in appearance as the fresh fruit.

Dehydrated loganberries when rehydrated may be served with cream and sugar; they may be preserved with syrup; they may be used for jam or jelly or they may be used for manufacturing fruit juice.

Raspberries

Raspberries dehydrate into a very fine product.

Strawberries

Strawberries are not recommended for dehydration.

Cherries

Cherries do not yield a very satisfactory product, considerable loss of the fruit sugar takes place in the dehydration process owing to what is termed bleeding or dripping of the juice.

Peaches

Experimental work at Penticton and Grimsby on dehydrating peaches has shown that some varieties of peaches are good for dehydration, some other varieties are fair, while other varieties are practically worthless. The good varieties will compare favourably with the imported product. The varieties tested as fair are so listed for one or more of the following reasons:

(*a*) Yield not good. (*b*) Flavour of finished product good but appearance not attractive. (*c*) Variety characteristics are such as to render the fruit difficult to handle; for example, some white fruit when ripe shows finger marks when handled. These marks show in the finished product.

Varieties listed as poor comprise the small varieties of cling-stone, some of the white fleshed varieties, and varieties which are of poor flavour and texture.

The Phillips, Muir, Tuscan, Elberta, Crawford and J. H. Hale all make good stock.

The Yellow St. John, and Belle of Georgia make a fair product.

The Triumph, Champion, Greensboro, Smock and Arp Beauty were not satisfactory.

The drying yield for peaches varied according to variety, size and maturity. Large peaches yielded considerably greater returns than did the small ones. Ripe peaches gave a better return than over-ripe ones, and much better returns than green ones.

Ripe Elberta peaches 2½ inches in diameter yielded a ratio of 5.1 to 1. Elberta peaches of the same quality but 2 inches in diameter required 6.5 to 1.

Over-ripe 2½-inch Elberta peaches showed a drying ratio of 8.3 to 1 while peaches of the same variety which were green (but not considered too green for fresh fruit shipment) required 11.8 to 1.

Experiments were run to ascertain, if possible, the increase in production in pounds of fruit from trees from which the fruit was picked for fresh-fruit shipment and similar trees on which the fruit was allowed to ripen to a proper condition for drying.

Ten trees, bearing approximately uniform crops, were selected in an orchard before any fruit was picked. Alternate trees were marked. The trees for fresh-fruit shipment were picked over three times and the weight of each picking recorded. The trees for dehydration were picked over twice when they were ripe enough for processing. The yield from the trees for dehydration was about 26 per cent greater than from those picked for fresh-fruit shipment. The difference in weight is accounted for by the increase in the growth of the fruit and the increase in the sugar content during the process of tree ripening.

Summing up the experiments on peaches it may be stated confidently that there is a good future for dehydrated peaches made from good stock, but that poor stock will not pay the cost of labour, etc.

Pears

The experiments with pears have shown that some varieties are good for dehydration while other varieties are not suitable.

Bartletts are the outstanding variety, Duchess makes a fairly good product, Flemish Beauty and Boussock are more expensive to prepare and do not give as good a product when redydrated, Keiffer pears are practically useless for dehydrating.

Probably there is no fruit which yields better results, with proper grading, than do pears. Table 3 shows the comparative yield of different sizes of Bartlett pears of the same maturity. It also shows comparative labour requirements. These figures are based on the yield of one ton of fresh pears of sizes 2 inches, 2¼ inches and 2½ inches.

TABLE 3—SHOWING THE COMPARATIVE YIELDS OF ONE TON OF DIFFERENT SIZES OF BARTLETT PEARS OF THE SAME MATURITY

—	2 inch	2¼ inch	2½ inch
Number of pears to peel	10,800	7,900	6,500
Number of pears to slice	10,800	7,900	6,500
Number of pears to core	21,600	15,800	13,000
Number of slices to trim	21,600	15,800	13,000
Number of slices to tray	21,600	15,800	13,000
Yield in finished pounds per ton, green	228 lb.	261 lb.	308 lb.
Drying ratio	8·7–1	7·6–1	6·5–1

It is well to note that difference in yield in this case is due entirely to waste in peeling and coring as the fruit was practically all of the same maturity.

Other experiments have shown great variation in the yield of pears, Bartlett yielding from 5.3 to 1 up to 9.3 to 1, while Flemish Beauty varied from 6.1 to 1 up to 10 to 1.

Plums

Numerous varieties of plums were tried, some giving very good results. Coe's Golden, Reine Claude, Empire, Yellow Egg, Maynard, Peach and Shiro after rehydrating for twelve to fifteen hours all made very good pie, preserve and jam stock.

There is some future prospect for a few varieties of dehydrated plums, but it will require considerable advertisement to get the public to try them. One thing is certain, the fruit must be ripe and graded for size to give a product at all satisfactory in appearance or flavour.

Prunes

A few experiments with prunes were tried at Penticton in 1924. Under proper conditions, British Columbia prunes will produce a good product. Indeed the Committee was so impressed with the result of their small experiments in 1924 that they decided to make special efforts in 1926.

One of the greatest difficulties with which prune-driers in the United States have had to contend has been to get the growers to leave their fruit on the tree until it was fully ripe. Unripe prunes are light in weight and make a very poor product.

In 1926 all the experiments with prunes were conducted under orchard control and careful data were gathered. A few fruit growers assigned to the Committee certain trees, the product of which was to be picked and delivered to the dehydrator at such time and in such condition as the management advised. The following conditions were to be observed.

(1) Only trees on clean ground were to be taken. This was to prevent puncture and other damage to such fruit as might fall to the ground.

(2) The ground underneath the prune trees was to be raked clear of leaves, stubs, fallen fruit and other rubbish about September 1; after that time the Committee was to take all the fruit which came from the trees.

(3) When the ripe prunes began to drop, arrangements were made for the first picking as follows: The picker selected the main limbs of the trees and gave each in turn two sharp vigorous shakes. The fallen fruit was gathered and delivered to the dehydrator. This procedure was followed at periods varying from five to ten days, according to the amount of fallen fruit found on the ground. When the fruit was fully ripe, soft, and mellow, the balance was taken. Table 4 gives details of fruit purchased and dehydrated at Penticton in 1926. This table gives the particulars of delivery of prunes from twelve growers. It shows the number of trees contracted, their age, their estimated yield on September 1, the actual yield and the average yield per tree.

TABLE 4—PRUNES

No.	Number of trees	Age	Estimated yield	Delivered yield	Average yield per tree	Date		Date		Date		High	Quality	Low	Quality	Increase
		years	lb.	lb.	lb.		lb.		lb.		lb.		lb.			per cent
1......	62	16	10,000	12,080	195	Aug. 25	192	Sept. 1	174	Sept. 22	139	192	90–120	139	50–60	38
2......	8	10	500	861	108	" 31	170	" 11	153	....	...	170	80– 90	140	50–60	21
3......	15	19	1,000	1,632	109	Sept. 2	148	" 20	124	....	...	148	70– 80	124	50–60	19
4......	125	6	8,000	9,948	80	" 2	140	" 16	124	....	...	140	70– 80	121	40–50	15
5......	16	7	2,000	2,868	180	" 3	140	" 18	116	....	...	140	70– 80	116	40–50	20
6......	21	14	3,500	4,113	196	" 3	165	" 29	130	....	...	165	80– 90	130	50–60	27
7......	32	15	3,500	5,149	161	" 4	183	" 11	161	....	...	183	80–100	146	50–60	25
8......	18	7	1,500	1,698	94	" 4	178	" 9	169	....	...	178	80– 90	150	50–60	19
9......	3	16	500	658	219	" 4	145	" 16	118	....	...	145	70– 80	118	40–50	23
10......	1	16	300	321	321	" 7	118	" 11	108	....	...	118	40– 50	108	30–40	9
11......	3	20	350	460	153	" 23	131	....	...	....	...	131	50– 60	131	50–60	....
12......	2	10	....	301	150	" 27	...	....	...	....	...	....	....	....	....	....

It also shows the number of prunes required by actual count to weigh 10 pounds (fresh fruit) at the various picking dates, the quality of the dried product at first and last picking, and the percentage of increase in yield to the grower by keeping his fruit for the dehydrator rather than selling it for fresh fruit shipment.

TABLE 5—PRUNES

Date	Number of boxes	Count per pound of fruit	Weight at date of picking	Estimated weight if picked Aug. 25
			lb.	lb.
Aug. 25	3	19·2	132	132
Sept. 1	18	17·4	757	686
" 6	24	16·4	87	74
" 11	3	15·6	122	99
" 17	32	14·4	1,599	1,198
" 18	63	14·1	3,111	2,284
" 20	70	14·0	3,459	2,522
" 22	56	13·9	2,813	2,042
			12,080	9,037

Table No. 5 shows the details of lot 1 of table 4.

The first column shows the date on which the prunes were picked. The second column shows the number of boxes delivered. The third column shows the number of prunes required to weigh one pound. This was arrived at by counting out three or four lots of ten pounds each at the time of delivery, actually counting the prunes in ten pounds and dividing the number by ten to get the average of one pound. The fourth column shows the weight of the actual delivery on the date in first column. The last column shows the estimated delivery had they all been picked on August 25, the time of the first delivery.

Now take the August 25 delivery in which there were 132 pounds of prunes, requiring 19.2 prunes to weigh one pound, and compare it with the September 11 delivery in which there were 122 pounds of prunes averaging 15.6 to the pound. If this last lot had been picked on August 25 when it required 19.2 prunes to make one pound, there would have been only 156/192 of 122 pounds, or 99 pounds. It will thus be seen that while the actual delivery was 12,080 pounds the weight would have been only 9,037 pounds had they all been picked on August 25.

TABLE 6—PRUNES

Early Delivery August 25, 1926—	
(19·2 fresh prunes weigh 1 lb.)	
Estimated crop if picked August 25	9,040 lb.
Value at 2½c. per lb	$226.00
Estimated dried yield 4·12 to 1	2,194 lb.
Value of dried product at 6c. per lb. quality 90–120	$131.64
Late Delivery September 22, 1926—	
(13·9 fresh prunes weigh 1 lb.)	
Estimated crop if picked September 20	12,400 lb.
Value at 2½c. per lb	$310.00
Estimated dried yield 3·1 to 1	4,000 lb.
Value of dried product at 9c. per lb. quality 50–60	$360.00
Increase in value, fresh	$ 84.00
Increase in value, dried	228.36
Sixty-two trees 16 years old—	
Average per tree	195 lb.
Increase, green	37 per cent
Increase, dried	173 per cent

Table 6 shows the yield and value comparisons of lot 1 table 4. In the early delivery the estimated crop is taken from table 5, using 9,040 pounds instead of 9,037 pounds.

In the late delivery the estimated crop is worked out in a very similar manner to that used in table 5.

The value, per green pound, is the price the Committee paid to the growers in 1926. The estimated yield in the early delivery is based on the actual drying ratio from the fruit delivered, i.e., it took 4.12 pounds of prunes delivered on August 25, 1926, to make one pound of dried prunes or the total yield on that ratio would be 2,194 pounds of dried prunes of a quality known as 90-120. These 90-120's (that is 90 to 120 dried prunes weigh a pound) are worth 6 cents per pound.

The estimated yield in the late delivery based on 3.1 to 1 would be 4,000 pounds. The late delivery made a quality graded as 50-60 and were worth 9 cents per pound.

The operating costs have not been added to these figures but as they are fairly well fixed they can be considered as an average.

Vegetables

Experiments have been carried on with various vegetables. Beans, beets, carrots, peas, pumpkin, potatoes, squash, spinach, and turnips all yielded satisfactory products. When re-hydrated they came back to an appearance and flavour almost as good as the fresh. Doubtless there is a great future for dehydrated vegetables in outlying points and indeed in the crowded portions of our cities but they must be well introduced before the public will appreciate them.

EXPERIMENTS IN DEHYDRATION CARRIED OUT BY THE DIVISION OF HORTICULTURE

This work carried out by the Horticultural Division of the Experimental Farms Branch dealt essentially with variety tests in dehydration, a study of the dehydrated product from the laboratory dehydrator as to quality, and finally a careful study of the best methods of using the product of different varieties through cooking, jam-making, jelly-making, and canning the refreshed product in comparison with the canned fresh fruit. Although this work perhaps was not done on as large a scale as would make it complete and comprehensive, yet a great deal of valuable data has been acquired which undoubtedly will be of value to commercial dehydration. All the dehydrated product of different varieties was graded on a basis of colour, flavour, etc., and then regraded on a basis of the product made therefrom. The following are some of the results:—

Plums: Coe's Golden Drop and Reine Claude produced the best flavour, while Empire, and Yellow Egg produced the best texture of dehydrated product. The first two of these made excellent jam.

Peaches: Crawford produced the best flavour and Elberta the best appearance of dehydrated peach. Even these varieties if picked too immature made an exceedingly poor and valueless product.

Cherries: Maturity is necessary in order to make a useful product that is at all comparable with fresh fruit when refreshed. Of the varieties used, the Blackcherry was the easiest to handle, showed the smallest loss of juice in pitting, and possessed a very choice flavour. If mature, all the six common Ontario varieties give excellent results.

Pears: The varieties tested gave first class results, made a splendid dehydrated product, which in turn made excellent marmalade, and also canned and baked exceptionally well.

Raspberries: Of the different varieties dehydrated, Newman gave the best results and made excellent pies and jams.

Strawberries: Of the varieties tested, Portia was the best.

Crabapples: Of the varieties tested, Virginia and Transcendent were outstanding. Results of dehydrated crabapples of different maturity showed beyond doubt that the riper the fruit the lower the value of dehydrated product if jellies were made therefrom; that is, the riper the fruit the lower the content of pectin, hence the lower yield of jelly.

Vegetables: Pumpkins dehydrated well and made first class pies. Asparagus and rhubarb, in all the various tests, were a complete failure. Carrots, peas, beets, potatoes, and turnips, all dehydrated well, refreshed easily, and made a first class product for cooking.

CHEMICAL INVESTIGATIONS IN DEHYDRATION

The following is a brief summary of the work carried on during the past four years by the Chemistry Division with the products dehydrated in the small laboratory dehydrator operated by the Horticultural Division.

(1) Study of the moisture content of fresh fruit vs. the dehydrated produce therefrom.

(2) Study of the sugar content of fresh fruit in the relationship of maturity and quality, both as a fresh and as a dehydrated product.

(3) Study of the relative acidity of plums, peaches, and other fruits before and after dehydration.

(4) Study of sugars, acids, etc., of fresh fruit vs. unpitted vs. pitted dehydrated fruit, using different treatments in bleaching.

(5) Relationship of sugars in dehydrated fruit through different treatments in bleaching, temperatures, dehydration, etc.

(6) The rates of loss of water due to various treatments of plums and peaches.

(7) Study of cherries in relationship to loss of sugars in dehydration; different treatments and temperatures in relationship to sugar content.

(8) The water content of fresh vs. dehydrated vegetables including pumpkins, carrots, beets, marrow, celery, potatoes, and squash.

This work has contributed some very useful data which will stand as an excellent record for the commercial dehydration of various fruits and vegetables in Canada. It does essentially emphasize the fact that fruit should be graded for maturity and size in order that the product may dehydrate uniformly and may have a uniform sugar content.

QUALITY OF CANADIAN DEHYDRATED FRUITS

The one significant fact in the operation of the Penticton and Grimsby plants is that certain Canadian fruits if properly matured, graded, and prepared, will make a quality of dehydrated product equal in grade, appearance and value to the very choicest products which are imported into Canada. Moreover, there is no doubt that the Canadian fruit, particularly apples and peaches, grown under Northern conditions have a flavour which, being retained in dehydration, should make Canadian dehydrated fruits outstanding. Whether or not this can be done commercially under present conditions is discussed later in this bulletin.

It cannot be too strongly emphasized that the size, maturity, and quality of the fresh fruit is the determining factor as to the quality and possible profits from dehydrated fruit. This applies equally to the future of the evaporation industry in Canada, and dehydration can only be built on this foundation. Each different type of fruit naturally has somewhat different requirements as to maturity, but green, unmatured fruit is certainly of little or no value for dehydrating purposes.

WHERE TO DEHYDRATE

A commercial two-tunnel dehydrator which has a capacity of 6,000 barrels or more of apples naturally must be located where such apples are available, and the same would apply with other fruits. Naturally a four-, six-, or eight-tunnel plant would have relatively higher capacity, and it might be generally stated that the greater the number of tunnels up to a reasonable point, the less will be the overhead charges per pound of dehydrated product. Hence, a quantity of fruit is necessary in order to meet the operating expenses and the overhead charges. This in itself means that dehydration, as evaporation, will be limited for the present to those areas which produce a bulk of fruit, particularly the Annapolis valley, southern Ontario, and the valleys of British Columbia.

Moreover, this quantity of fruit must be limited to a relatively small number of varieties and those varieties which particularly lend themselves to dehydration, if dehydrated Canadian fruit is to assume a distinctive place on the Canadian or export markets. This is a point which, as yet, has been all too little appreciated even by our evaporators, and is probably one of the greatest retarding factors toward greater consumption and greater demand for Canadian evaporated apples.

WHAT FRUITS TO DEHYDRATE

Canada is now producing large quantities of apples, and considerable quantities of peaches and pears. These three classes of fruit lend themselves very well to dehydration. Canada produces only a relatively small quantity of cherries, loganberries, plums and apricots. These all lend themselves very well to dehydration. The Okanagan valley, which now has relatively large areas set out to apricots, should carefully consider the matter of dehydration for, once the present orchards reach heavy bearing, there will be far more fruit than is necessary to meet the requirements of the domestic canning and the fresh fruit trade. Whether or not these varieties are sufficiently limited in numbers as to lend themselves to uniform dehydrated product is not known.

The Okanagan valley also lends itself particularly well to prunes and there should be large plantations of one or two of the best types of prunes which would be the basis of proper production of a product suitable for dehydration. The work at Penticton in 1926 showed beyond doubt that the choicest of dehydrated prunes can be produced, and will compare most favourably with the very finest of imported sorts.

A profitable commercial dehydrator must be operated on the basis of fruit graded in, and the product graded out, of the plant on packing. This grading includes both size and maturity. It is ridiculous to expect that an evaporater or dehydrator can produce from low-grade, unmarketable cull fruit, a high quality, saleable product which will be the basis of an industry. It is quite true that once the dehydration industry is well established a small proportion of low-grade fruit might possibly be processed to meet a special low-grade market, but until Canadian-grown dehydrated fruit meets with popular demand, this should be a secondary consideration.

That there is a distinct difference as to suitability of different varieties for dehydration is well established.

Reference has already been made to some of the most suitable varieties dehydrated in Canada. During the year 1925 at the Grimsby plant, Greenings and Baldwins gave the best results.

Generally speaking, however, results have shown that of the large numbers of varieties which we have of apples, peaches, pears, etc., a relatively limited number lend themselves particularly well to dehydration, and if a specialized industry is to be established, then there must be relatively large plantations of these most marketable and most suitable varieties, as is the case in California where we find the following: Sutter county alone has 14,000 acres of peaches for canning purposes confined practically to two varieties. Santa Clare is the centre of the apricot industry and the apricots are practically all of one type. The Watsonville district produces as many apples as the province of British Columbia and 75 per cent of these are of one variety, Yellow Newtown. St. Joaquin produces most of the peaches for dehydration and they have but two varieties, Muir and Lovell.

It would certainly appear that our present fruit plantations do not lend themselves at the present time to extensive dehydration, or for that matter, high class evaporation products, due to the multiplicity of varieties.

SOURCE OF FUEL

As previously stated the Grimsby plant has its fuel supply from a steam-boiler some 380 feet distant and other than the heat loss this has been very satisfactory. On the other hand, the Penticton plant has been heated from oil-burners. Because of the high cost of oil, and for other reasons, it has been definitely decided that steam from a steam-boiler is a more economical and satisfactory source of heat. Steam heat was used in this plant in 1926.

The dehydrator affords a very considerable saving in the matter of fuel. It is usually estimated that an evaporator requires one ton of hard coal per ton of dried fruit or a cost of say $16.50 for fuel. On the other hand, the Grimsby dehydration plant used only about two tons of soft coal per 2,100 pounds of dried fruit or a charge of $10.80 per ton of dried fruit. This is on a basis of a twenty-hour day, and the cost would be still further reduced by operating twenty-four hours a day. Even this is not a fair index as to the amount of fuel which might be saved because of the fact that the distance from the boiler to the dehydrator was 380 feet, with a consequent loss of heat. The temperature at the boiler was 120° while at the dehydrator it was only 90°. In other words, one-third of the heat was lost in transit, which could have been avoided were the source of heat immediately adjacent to the dehydrator.

LABOUR

As in the case of handling an evaporator, experienced labour is by far the most economical. Experience has shown that it is essential to have an experienced foreman in charge otherwise the work may quite easily be ruined with a very little carelessness, or lack of oversight in the tunnel itself, or through lack of care in properly curing the dried product before storing and packing. In like manner, experienced help in preparing fruit is by far the most economical; a difference of between four and seven bushels peeled per person per hour naturally means the difference between high and low cost, and this applies to every phase of preparing, dehydrating and packing of fruit.

COST OF FRUIT

Until such time as high quality dehydrated fruit meets with proper recognition on the domestic and export markets, the price which can be paid for fruit for dehydration can be very little more than is paid by evaporation plants.

Moreover producers with an available surplus of high-quality fruit for evaporating or dehydrating must make some sacrifice in order to establish in the minds of the purchasers what high-quality fancy dried fruit actually is. These remarks pertain particularly to apples.

Generally speaking from 75 cents to $1 per barrel may be paid for good-sized fruit of uniform grade. Small-sized and cull fruit is not worth anything for dehydration purposes because of the very high cost of handling and the very low value of the finished product.

COST OF DEHYDRATION PLANT

This naturally would vary with conditions. If a suitable building were available at a very low price then the cost of installing two or more tunnels, the necessary trays, bleaching-boxes, carriers, trimmers, boxes, peelers, etc., is very easy to determine. Moreover, if a good second-hand boiler were available as a cheap source of heat and if electricity were readily available at low cost as a source of power for the dehydrator fan, here again the initial outlay would be proportionately low.

COST OF OPERATION

Some figures have been given in the preceding pages as to the cost of fuel. In like manner, there were given figures as to the cost of peeling and preparing fruits of different sizes and quality. But the Penticton plant was a non-commercial type, and the Grimsby plant, even though containing a commercial dehydrator, did not have the preparation rooms, curing rooms, storage and sorting-rooms, and above all, such labour-saving devices as automatic carriers and power-driven peelers, etc., and therefore was not comparable to a commercial plant; hence the figures as to expenditure on labour are not to be considered as approximating those which would be found in a commercial plant. Moreover, in the various years of operating the Grimsby dehydrator there has not been a steady run of twenty or twenty-four hours per day with full capacity for the two tunnels of a limited number of lots and varieties. This is quite out of line with commercial practices. In view of this, the figures as to cost of operating, and returns, from the Grimsby plant are of no particular significance in the study of the economics of a dehydration plant. As long as these dehydrators are expected to give comparative data as to varieties, state of maturity, yields from various sizes of fruit, etc., etc., they will remain non-commercial. After all, these dehydrators were built especially to discover two factors, namely:—

(1) Can Canadian fruit be made into a first class dehydrated product, and
(2) What are those factors which contribute toward quality in dehydrated fruit and how may they be obtained.

COMMERCIAL DEHYDRATION PLANTS

Since the experimental dehydrators were established by the Federal Government in the year 1923, there have been a few commercial plants established; these are as follows:—

(1) *Aylesford, N.S.* This plant is operated in direct and immediate competition with an evaporator and hence comparative figures ought to be available. Unfortunately however, both the evaporator and the dehydrator are

handling a very high proportion of small low-grade fruit from which fancy or even a good standard dried product can scarcely be obtained in any considerable quantity.

(2) *Bullman's Dehydrator, Vernon, B.C.* This plant has only been operated for one year but is producing an excellent quality of fruit, particularly dehydrated apples.

(3) *Port Williams, N.S.* This plant was only constructed in 1926, and is of the same general type as the Aylesford plant. What its commercial success may have been during its first year of operation is not yet known.

(4) *Ontario Hospital, London, Ont.* At this institution there has been established a semi-commercial plant of the cabinet type. The purpose is to dehydrate fruits grown on the farm for use in the institution. Since labour is not a factor at such an institution, this dehydrator would be quite satisfactory. Any lack of success in operating this plant, to date, has been due largely to inexperience.

SUMMARY

Dehydrated fruit retains the natural flavour to a very much greater degree than ordinary evaporated fruit. In addition dehydrated fruit, when properly soaked, refreshes almost to the original fresh weight, whereas evaporated fruit still shows a shortage of 20 per cent of the original weight after refreshing.

The process of handling fruit for the dehydrator or evaporator, i.e., peeling, slicing, bleaching and all such preparation, is exactly the same in each case. The sweating or curing of dried fruit after it has come from the dehydrator and evaporator is practically the same in both cases.

The results of these investigations might be briefly summarized as follows:—

(1) It is impossible for a dehydrator to make a good product from low-grade fresh fruit.

(2) The hope for permanency and prosperity in the Canadian dried-fruit industry lies in creating a greater confidence therein by both the domestic and foreign trade, and by emphasizing high quality. This can be done perhaps more effectively through dehydrators than through the evaporators. A reduction in costs is equally important. The dehydrator, once established, can operate at a lower cost per ton of dried fruit than the evaporator.

(3) The fruit-growers themselves must carefully consider the matter of their plantations in relationship to dehydration. It is impossible to expect a trade to be developed on an insecure supply of a large number of varieties. Hence, our fruit plantations must be somewhat remodelled with that end in view.

(4) Dehydrated fruit must be considered a fruit product and not a mere by-product.

(5) It would be wise for those considering plantations for dehydration purposes to carefully consider the relationship between the dried-fruit industry and other phases of the fruit industry. Often the dehydration plant should either be operated under the same company, or in close co-operation with the fresh-fruit warehouses, the canning-plants, cider plants, cider and fruit-juice plants, jam, jelly, and marmalade plants.

(6) There still remains considerable work to be done to thoroughly classify the suitability of uniformly good grades of the different varieties of our various fruits and vegetables.

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