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A SUPPLEMENT TO THE REPORT ON A TRANSPORTATION
TEST WITH DELICIOUS APPLES UNDER HEATER SERVICE
FROM WENATCHEE, WASHINGTON TO JERSEY CITY, NEW
YORK CITY, AND PHILADELPHIA: A STUDY OF THE
TEST FRUIT USED IN THE TRANSPORTATION WORK.
JANUARY 1946

By

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Object of Using Test Fruit

The effect of the different kinds of cars and car heaters on the fruit was studied. Test lots of apples were placed in similar positions in all cars for comparison after arrival at destination.

History of Test Fruit Prior to Shipment

The fruit was grown at the Tree Fruit Experiment Station, Wenatchee, Washington being a part of approximately 500 boxes of loose fruit placed in commercial storage at 34° to 40°F. on October 4, 1945, after a delay of 1-1/2 days in the orchard. The entire lot was held in storage for 11 days and then commercially washed, (sodium silicate 76 lbs. per 100 gal. at 110°F. and hydrochloric acid 1% at 105°F.), sorted, and graded. One hundred and twenty boxes in sizes 100 to 125 were selected from the original 500 and thoroughly composited and packed in standard wooden apple boxes.

Part of this fruit was then placed immediately at 31° and kept at this temperature until used. It is referred to herein as "immediate storage 31°," and is representative of fruit handled under the better commercial handling practices now used in the Wenatchee district.

A second lot of 16 packed boxes of similar fruit from the original lot was given an additional delay of 4 days at 65° and then stored at 36°F. for 2 weeks prior to being placed at 31°. This lot was representative of fruit given poorer commercial handling and is referred to herein as the "delayed storage" lot.

Handling of Test Lots during Transit and at Destination

Thirty two standard wooden boxes of packed test fruit were used. Each of 8 cars carried one box of immediately stored and one box of delayed storage fruit at the top quarter length and bottom doorway positions where the largest temperature differences are usually found in refrigerator cars moving under heater service.

Upon unloading at New York and Jersey City, all test boxes were removed to the government laboratories where they were held at 44°F. for a period of 24 to 48 hours before sampling for condition, dessert quality, and chemical analyses. Comparable samples of test fruit were also held at 60° to 70°F. for 4 days to simulate retail handling.

Methods of Evaluating Changes in Test Fruit

Firmness of the fruit was measured with a Ballauf pressure tester using a 7/16-inch plunger on the pared surface of 3 sides of 10 representative apples.

The soluble pectin content in the fruit was determined by macerating segments from 20 fruits, expressing the juice and precipitating the soluble pectin therein as calcium pectate.

Dessert quality was determined by judging the texture and flavor of at least 20 fruits in each lot according to the following score card:

<u>Flavor</u>	<u>Numerical rating</u>
Full (typical aromatic Delicious taste)	40-50
Moderate (not quite full varietal flavor).....	30-40
Slight (not neutral to taste, but lacking in flavor). 20-30	
Stale (strong after taste, acetaldehydic).....	0-20

<u>Texture</u>	
Firm	45-50
Crisp	35-45
Soft	25-35
Mealy	15-25
Breakdown	0-15

<u>Dessert Quality Rating</u> (Texture and flavor)	
Excellent	90-100
Good	75-89
Fair	51-75
Poor	0-50

Results

Changes in Fruit During Handling and Storage Prior to Transit

The firmness and soluble pectin content of the immediate and delayed storage lots of fruit, held for use in the transportation test, were determined on November 5, 1945, in order to measure changes due to handling procedures following harvest. Similar analyses were again made on comparable samples on January 12, 1946 just prior to shipment. The latter show the changes that occurred during storage. These results are summarized as follows:

<u>Time of Sampling</u>	<u>History of Sample</u>	<u>Firmness (lbs. Pressure)</u>	<u>Soluble Pectin %</u>	<u>Dessert Quality Rating</u>
November 5, 1945	Immediate Storage	15.5	0.0512	-
	Delayed Storage	12.5	.1202	-
January 12, 1946	Immediate Storage	13.7	.0675	80
	Delayed Storage	10.1	.1250	54

These data show that during the delayed handling and storage period the apples lost 19.3% in firmness and gained 134.7% in content of soluble pectin (degree of ripeness) by the time the fruit was placed in permanent storage at 31°F. During the subsequent period of approximately 2 months at 31°, fruit in the immediate storage lot, lost 11.6% in firmness while the delayed lot lost 19.2% or a total reduction in firmness from time of harvest of 38.5% for the latter.

The data show that the degree of ripening (soluble pectins) prior to shipment had more than doubled in those lots of test fruit which had received the poorer handling and storage. The important thing to remember is that this change in composition is many times greater than that which occurred as a result of even the most adverse transit conditions encountered under heater service on the test trip. (See Table 1, Car WFE 65184). In other words, the dessert quality of the Delicious apple in the hands of the consumer was determined to a much greater degree by the handling of the fruit prior to shipment than by the conditions to which it was subjected during shipment.

Changes in the Fruit During Transit and After Arrival at Destination

Data relative to the dessert quality and composition of the test lots as influenced by conditions in transit are summarized in Table 1.

100

100

100

With but one exception, the average transit temperature at the top quarter length position in all cars was near 36.5°F. while that at the north side bottom doorway held near 31°. Under heater service, these average commodity temperatures may be considered satisfactory; the data on composition of the test fruit indicate as much. In most instances variation in comparable lots was great enough to mask any significant differences in composition resulting from different conditions in transit. However, when the average change in composition of all of the immediate storage lots is considered, best quality was found in those subjected to the lower temperatures that prevailed at the bottom doorway position.

For the immediate storage lots and depending upon their position in the car, the data in Table 1 show an average increase in soluble pectin content of approximately 31-39% upon arrival and a further increase of about 4-8% after 4 days on the market. Their dessert quality rating of 80 at the start had dropped only about 10 points at destination. In no instance did shipment under heater service cause a loss in quality of these test lots at all comparable to that caused by poor handling and storage prior to shipment.

In contrast the delayed storage lots with a dessert quality rating of only 54 when shipped, were so ripe and mealy that the content of soluble pectin increased only 2-13% during transit and an additional 6-8% after 4 days on the market. Due to their advanced stage of ripeness at time of shipment the dessert quality of these lots was not appreciably altered by the highest temperatures resulting from the use of car heaters. From the consumers standpoint this means that if the potential storage life and dessert quality of Delicious apples has been largely lost through improper handling and storage, high transit temperatures are much less important than with fruit which has excellent quality at time of shipment. This is an important point to stress since the general opinion among shippers is quite the opposite.

Table 1

Influence of Storage, Transit, and Retail Handling
on the Composition and Dessert Quality of Delicious Apples.

(Heater Transportation Test Wash.-New York January 1946)

Refrigerator Car Number	Average Temperature of test fruit during transit °F.	Upon Arrival at Destination				After Holding for 4 Days at 60° to 70°F.			
		Firm-		Soluble Pectin		Dessert Rating	Firmness Lbs. Pressure	Soluble Pectin	
		Dessert Rating	ness Pres-sure	In Tissue	Increase in Transit			In Tissue	Increase on Holding
				o/o	o/o			o/o	o/o
(Test Fruit Stored Immediately 31° F. Transported Top Quarter Length in Cars)									
WFE 65184	43.4	70	12.0	0.0900	33.5	65	11.5	0.0960	6.6
BRE 74602	37.0	68	12.8	.0925	37.0	65	11.7	-	-
WFE 66471	34.5	67	12.0	.0875	29.4	70	12.0	-	-
FGE 35284	37.5	65	12.6	.0975	44.4	73	11.6	.0994	1.9
BRE 74579	35.9	73	11.4	.1050	55.5	75	11.9	-	-
WFE 65877	35.7	65	13.0	.1024	51.7	60	11.0	-	-
BRE 74616	36.2	75	12.4	.0775	14.8	60	11.8	-	-
WFE 65570	36.6	75	12.5	.0975	44.4	70	11.1	-	-
Average of All Cars		69.7	12.3	0.0937	38.8	67.2	11.5	0.0977	4.2
(Test Fruit Stored Immediately 31° F. Transported Bottom Doorway North Side in Cars)									
WFE 65184	28.8	70	12.9	0.0875	29.6	75	11.7	0.0950	8.5
BRE 74602	32.5	73	12.8	0.0975	44.4	70	11.3	-	-
WFE 66471	31.1	68	12.0	.0825	22.2	80	12.1	-	-
FGE 35284	30.5	68	12.4	.0920	36.2	73	11.7	.0950	3.2
BRE 74579	31.4	75	12.3	.0824	22.2	75	11.5	-	-
WFE 65877	29.2	72	13.0	.0910	34.6	78	11.6	-	-
BRE 74616	31.1	75	13.2	.0910	34.6	70	11.9	-	-
WFE 65570	31.6	75	13.0	.0825	22.2	75	12.0	-	-
Average of All Cars		72.0	12.7	0.0883	30.8	74.5	11.7	0.0950	7.5
(Test Fruit Delayed Storage Transported Top Quarter Length in Cars)									
WFE 65184	43.4	55	10.0	0.1475	18.0	50	9.0	0.1650	11.8
BRE 74602	37.0	50	10.5	.1325	6.0	60	10.0	-	-
WFE 66471	34.5	55	10.0	.1250	0.0	45	9.8	-	-
FGE 35284	37.5	55	10.1	.1375	10.0	40	9.3	.1350	0.0
BRE 74579	35.9	55	10.4	.1600	28.0	35	9.0	-	-
WFE 65877	35.7	55	10.9	.1500	20.0	45	9.5	-	-
BRE 74616	36.2	55	10.5	.1376	10.0	35	9.1	-	-
WFE 65570	36.6	50	9.8	.1424	13.9	45	9.7	-	-
Average of All Cars		54.0	10.2	0.1415	13.2	44.3	9.4	0.1500	6.0
(Test Fruit Delayed Storage Transported Bottom Doorway North Side in Cars)									
WFE 65184	28.8	55	10.4	0.1250	0.0	65	9.6	0.1500	20.0
BRE 74602	32.5	60	9.9	.1275	2.0	55	9.4	-	-
WFE 66471	31.1	55	9.8	.1325	6.0	50	9.6	-	-
FGE 35284	30.5	51	10.6	.1100	0.0	45	9.6	.1250	13.6
BRE 74579	31.4	55	10.6	.1200	0.0	35	10.0	-	-
WFE 65877	29.2	55	11.2	.1375	10.0	50	10.3	-	-
BRE 74616	31.1	55	10.5	.1575	26.0	45	10.6	-	-
WFE 65570	31.6	50	11.2	.1300	4.0	50	11.2	-	-
Average of All Cars		54.5	10.5	0.1275	2.0	49.3	10.0	0.1375	7.8