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Further tests with vacuum precooling on fruits and vegetables. Salinas, Calif. August, 1949.

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Report of a study in which certain phases were carried on under the Research and Marketing Act of 1946. RM:c 52

Division of Fruit and Vegetable Crops and Diseases

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Purpose

During the time shipping tests were being made at Salinas, California, with 3 heavy loads of dry packed lettuce precooled by the vacuum cooling method it was possible to include small test lots of other commodities to see if they could be cooled as effectively as lettuce. Grapes and strawberries as well as some prepackaged vegetables including celery hearts, spinach, and shredded salad and soup mixes which were available at the time were precooled with the lettuce and held for observation.

Equipment and Material

The tests were made at the Vacuum Cooling Company's plant with the large vacuum tanks described by James Clements in his report of June, 1949, and which are used to precool lettuce on a carlot scale.

Grapes of the Ribier variety were selected because of their large size to be compared with the much smaller berries of the Thompson Seedless variety. The strawberries used were large, firm, and dry (variety unknown). Grapes and strawberries with bruised spots or cracked skin were kept separate from sound fruit with unbroken skin so that pressure injury would be apparent if it occurred. The prepackaged vegetables were contained in 10 oz. and 16 oz. Lumerith bags closed with folded cardboard stapled at the top.

Results

A comparison of the reduced pressure prevailing in the tank and the temperature of a head of lettuce located in the center of a crate (Table 1) shows very little cooling during the initial 13 minutes required to evacuate the tank to a vacuum of 29.6 in. Hg. During the next 9 minutes with the vacuum increasing gradually to 29.9 in. the lettuce cooled 14° F. from a temperature of 55°. Further holding at 29.9 in. vacuum for 13 minutes cooled the lettuce to a temperature of 31° followed by slight reheating due to the heat of compression of the air in the tank as the vacuum was released at the end of the precooling period. Thus, under commercial conditions, time is a factor in removing heat from produce by vacuum cooling as well as by other cooling methods.

A comparison of the temperature of several commodities held under high vacuum for 20 minutes (Table 2) shows that celery, grapes, and strawberries cool slowly whereas spinach and the shredded salad and soup mixes cool about as fast as lettuce. There is apparently a big difference in rate at which various commodities cool under vacuum. Celery the most bulky item tested, cooled faster than grapes or strawberries and large grapes cooled as fast as small ones. The time required to cool bulky commodities like celery and fruit by vacuum probably would be too long to be economically feasible.

1/ Report of a study in which certain phases were carried on under the Research and Marketing Act of 1946." RMA: [illegible]

Vacuum cooling is accomplished by evaporating moisture from the product to be cooled. Uninjured grapes and strawberries cooled slower than those with broken skins exposing moist tissue. The weight loss of prepackaged vegetables during vacuum cooling ranged from 2.2 pct. to 3.2 pct. (Table 3) which is close to the theoretical amount of evaporation needed for the cooling obtained. The weight loss with lettuce - not shown in the table - was similar with that of the prepackaged vegetables. The grapes and strawberries were not weighed.

There was no splitting of the bags used for the prepackaged vegetables caused by the high vacuum probably because the stapled closure was not air tight. There was no visible wilting or injury of the lettuce or rupture of the skin of grapes or strawberries. It was thought that possibly minute injuries not noticeable immediately after vacuum cooling might cause excessive wilting during subsequent holding, but there was no difference in appearance or in weight loss between vacuum cooled lots and non-treated checks during such a holding period.

Table 1. Temperature of Iceberg lettuce (center of dry packed crate) during vacuum precooling at Salinas Aug. 1949.

Time Min.	Vac. In. Hg.	Lettuce Temp. °F.	Time Min.	Vac. In. Hg.	Lettuce Temp. °F.	Time Min.	Vac. In. Hg.	Lettuce Temp. °F.
1	8.5	56	14	29.75	53.0	27	29.90	35.8
2	16.0	56	15	29.78	51.0	28	29.90	35.0
3	21.5	55.8	16	29.80	49.0	29	29.90	34.0
4	24.9	55.5	17	29.80	47.5	30	29.90	33.5
5	26.4	55.5	18	29.82	46.0	31	29.92	33.0
6	27.1	55.5	19	29.85	45.0	32	29.92	32.5
7	27.6	55.5	20	29.87	43.5	33	29.93	32.0
8	28.0	55.5	21	29.89	42.0	34	29.50	31.3
9	28.4	55.5	22	29.90	41.0	35	26.50	31.0
10	28.8	55.5	23	29.90	39.8	36	17.50	31.0
11	29.1	55.3	24	29.90	38.5	37	8.00	31.0
12	29.4	55.3	25	29.90	37.8	38	0.00	31.3
13	29.6	55.0	26	29.90	37.0			

Table 2. Effect of 20 minute exposure to vacuum of 29.5" to 29.9" Hg. on cooling of various commodities.

Commodity	Temperature (°F.)		
	Before Cooling	After Cooling	Dro
elery hearts in Lumerith bags	66	47	19
rapes			
Large Ribier, unbroken skin	69	63	6
do. broken skin	69	56	13
Small Thompson Seedless, unbroken skin	70	64	6
do. broken skin	70	58	12
trawberries, Sound, dry	65	53	12
do. Bruised, moist	65	48	17
ettuce, Iceberg, dry pack	72	32	40
alad mix in Lumerith bags	65	35	30
oup mix in Lumerith bags	62	34	28
Spinach in Lumerith bags	66	35	31

Table 3. Effect of 30 minute exposure to vacuum of 29.5" to 29.9" Hg. on weight loss of various commodities in stapled Lumerith bags.

Commodity	Weight loss (pct.) During Vac. P.C.	After 1 Day	After 2 Days
Celery, vacuum lot	2.7	2.7	3.2
do. check lot	0	.9	2.6
Salad mix, vacuum lot	3.2	3.2	4.4
do. check lot	0	0	1.6
Soup mix, vacuum lot	2.2	2.2	2.8
do. check lot	0	1.6	2.4
Spinach, vacuum lot	3.2	4.8	8.8
do. check lot	0	2.3	6.6