Effect of Blanching and Freezing on the Texture and Color of Candied Citron[1]

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ABSTRACT

Good quality candied citron was obtained from frozen pulp to which different blanching treatments had been given. Freezing citron without blanching gave the softest product. Frozen citron cubes blanched for 1/2 min in water at 170° F (76.7° C) gave a candied product with similar characteristics to the one obtained by fermenting the fresh fruit. The greatest destruction in green pigments is observed in the frozen pulp given no treatment, and in the pulp blanched in water and $CaCl_2$ solution for a period of 3 min. Freezing citron means considerable savings in storage space, shipping costs, and salt.

INTRODUCTION

Citron (*Citrus medica* L.), used for candying is fermented or cured in either sea water or in a 5 to 8% table salt solution (2, 3, 4). The brined peels are stored and shipped in casks with fresh brine of a higher concentration of salt than that used in curing. This process takes up much storage space, and shipping costs are high because of the heavy weight of the brine barrels.

No study has been found in the literature on the freezing of citron for candying. This study was done to determine the effect of blanching and freezing on the texture and color of fermented candied citron prepared from frozen fruit.

MATERIALS AND METHODS

The fruits used were obtained from Adjuntas, a highland area of Puerto Rico. The fruits were sorted according to maturity; only green fruits were processed. They were dipped in water at 120° F (48.9° C) for 20 min, dried well, and processed immediately or stored at 45° F (7.2° C) until used. After being washed, the fruits were sliced in quarters and the endocarp (juice sacs and seeds) removed, either by an electric paring machine or by hand.

The fruit was diced by an Urschel Model G machine[3] equipped with a

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[3] Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

3/8 in dicing attachment with the cutting blade adjusted to obtain a 1/4-in cube.

The diced citron was blanched by means of the following treatments: 1) dipping in hot water at 170° F (76.7° C) for 0, 1/2, 1, 2, and 3 min, respectively; and 2) dipping in a solution of 0.5% $CaCl_2$ at 170° F (76.7° C) for the same intervals used in hot water blanching. In all blanching treatments a ratio of 1 part fruit to 4 parts water or $CaCl_2$ solution was used.

After being blanched the diced citron was spread on a stainless steel table to cool, packed in polyethylene bags, and stored in a freezer at −10° F (−23.3° C).

The diced citron blanched with and without $CaCl_2$ for a period of 3 min was stored for 22 mo prior to curing and candying. The fruit treated for 1/2, 1, and 2 min, with and without $CaCl_2$, was stored for a period of 10 mo.

As a control, citrons were fermented and cured without blanching or freezing. The brined cubes were stored at room temperature 81°F (27.2° C) −93°F (32.4° C).

The frozen cubes were thawed at 45° F (7.2° C) and fermented and cured by the method described by Cancel and Hernández (1), except that recycled brine was used for the 2-day fermentation period.

The fermented fruit was candied as described by Cancel and Hernández (1), packed in glass jars and stored at room temperature for 1 year. All samples were analyzed monthly for shear press, sugars, and green pigments.

Shear press measurements were taken on 125 g samples of diced candied citron with an Allo-Kramer press. The maximum force was read directly from the time-force curves.

For measurement of the intensity of the green color, the candied cubes were extracted with methanol. An absorption curve of the methanol extract was made in a Beckman DBG spectrophotometer in the visible range. Maximum peaks were observed at 650 and 425 nm.

Total and reducing sugars were determined by the Lane and Eynon method (5).

RESULTS AND DISCUSSION

EFFECT OF BLANCHING TREATMENTS AND COLD STORAGE ON QUALITY

A candied product of good quality and appearance was prepared from blanched pulp stored at −10° F (−23.3° C) for 10 and 22 mo respectively.

Shear press measurements (fig. 1) indicate that freezing citron without any previous treatment gave a product of a softer texture than the one prepared by the conventional method of fermenting fresh fruit. Blanching for a period of 1/2 min gave a product with a texture similar to or better

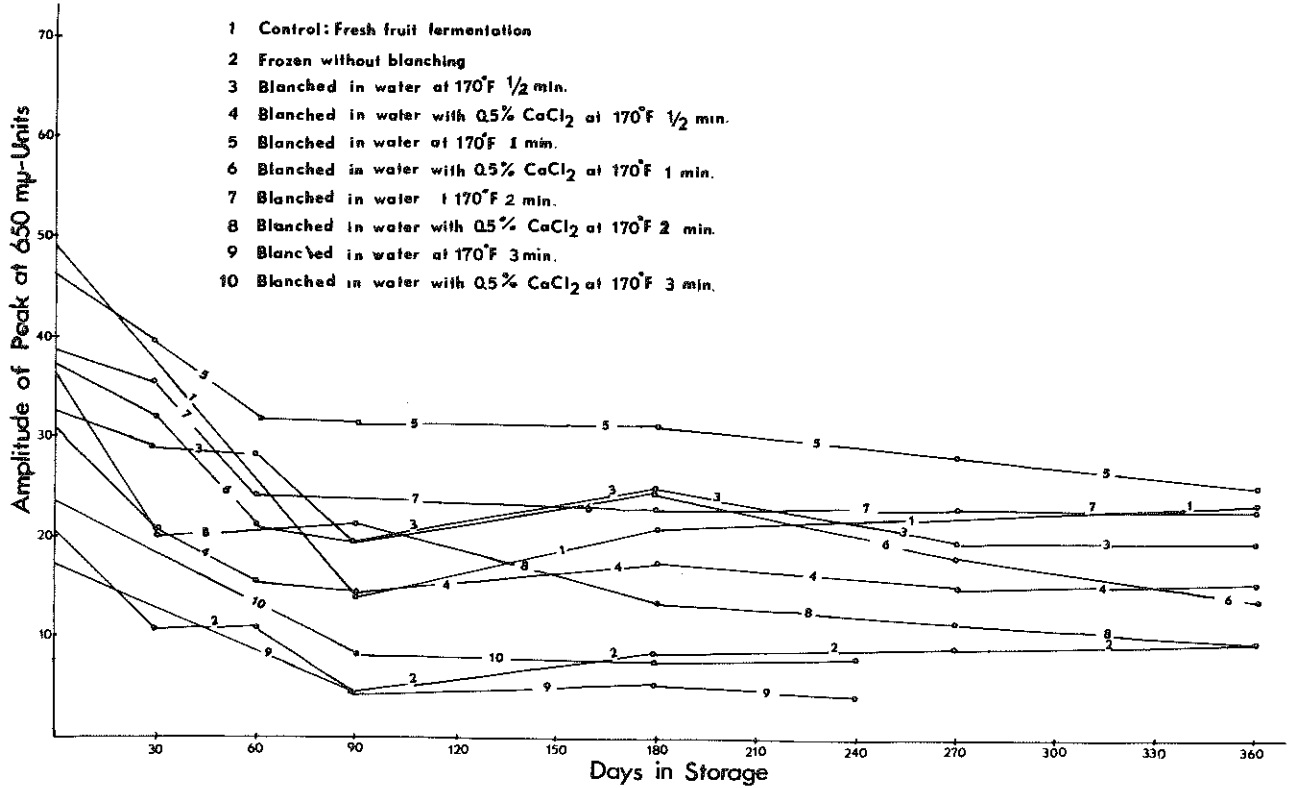

FIG. 1.—Changes in shear press in candied citron prepared from frozen pulp.

TABLE 1.—*Effect of method of preservation, blanching treatment and time of storage on the ratio of reducing to total sugars*

Method of preservation	Blanching treatment	Ratio at storage intervals in days indicated				
	MIN					
		0	30	90	180	360
Fermented	None	—	.28	.30	.33	.36
Blanched in water and frozen	None	.30	.30	.31	.33	.37
	1/2	.29	.29	.35	.32	.34
	1	.29	.29	.29	.30	.33
	2	.29	.29	—	.29	.33
	3	.29	.28	—	.31	—
Blanched in .5% $CaCl_2$ solution and frozen	1/2	.27	.27	.30	.28	.31
	1	.28	.28	.29	.28	.32
	2	.28	.29	.29	.29	.32
	3	.27	.28	—	.29	—

than the one obtained from fermented fruit. The longer blanching period and the addition of $CaCl_2$ resulted in products that were much harder in texture.

A product with an intense deep green color was obtained with all the treatments except that 3 min of blanching, and freezing the pulp without blanching produced less intense greenness.

EFFECT OF TREATMENTS ON SHELF LIFE OF CANDIED CITRON

Table 1 shows the effect of the method of preservation, blanching treatments and time of storage on the reducing and total sugars. Since during storage some dehydration of tissue takes place, and since no change in total sugars was observed to take place in any of the samples, reducing sugars were calculated as the ratio of reducing to total sugars. In all samples the reducing sugars increased during storage. The sample frozen without blanching showed the highest increase in reducing sugars, while in the blanched samples, irrespective of the blanching treatment, the change was comparable to that observed in the fermented sample.

All of the treatments showed a sharp decrease in green pigments during the first 3 mo of storage (fig. 2). The greatest discoloration occurred in the pulp frozen without blanching and in the pulp blanched for 2 min in both water and $CaCl_2$ solution.

The results suggest that citron for candying may be preserved by freezing, with considerable savings in salt, storage space, and shipping costs.

RESUMEN

La cidra corrientemente se cura en salmuera y luego se almacena o se transporta en otra mucho más concentrada. Esto requiere un gran

1 Control Fresh fruit fermentation
2 Frozen without blanching
3 Blanched in water at 170°F ½ min.
4 Blanched in water with 0.5% $CaCl_2$ at 170°F ½ min.
5 Blanched in water at 170°F 1 min.
6 Blanched in water with 0.5% $CaCl_2$ at 170°F 1 min.
7 Blanched in water at 170°F 2 min.
8 Blanched in water with 0.5% $CaCl_2$ at 170°F 2 min.
9 Blanched in water at 170°F 3 min.
10 Blanched in water with 0.5% $CaCl_2$ at 170°F 3 min.

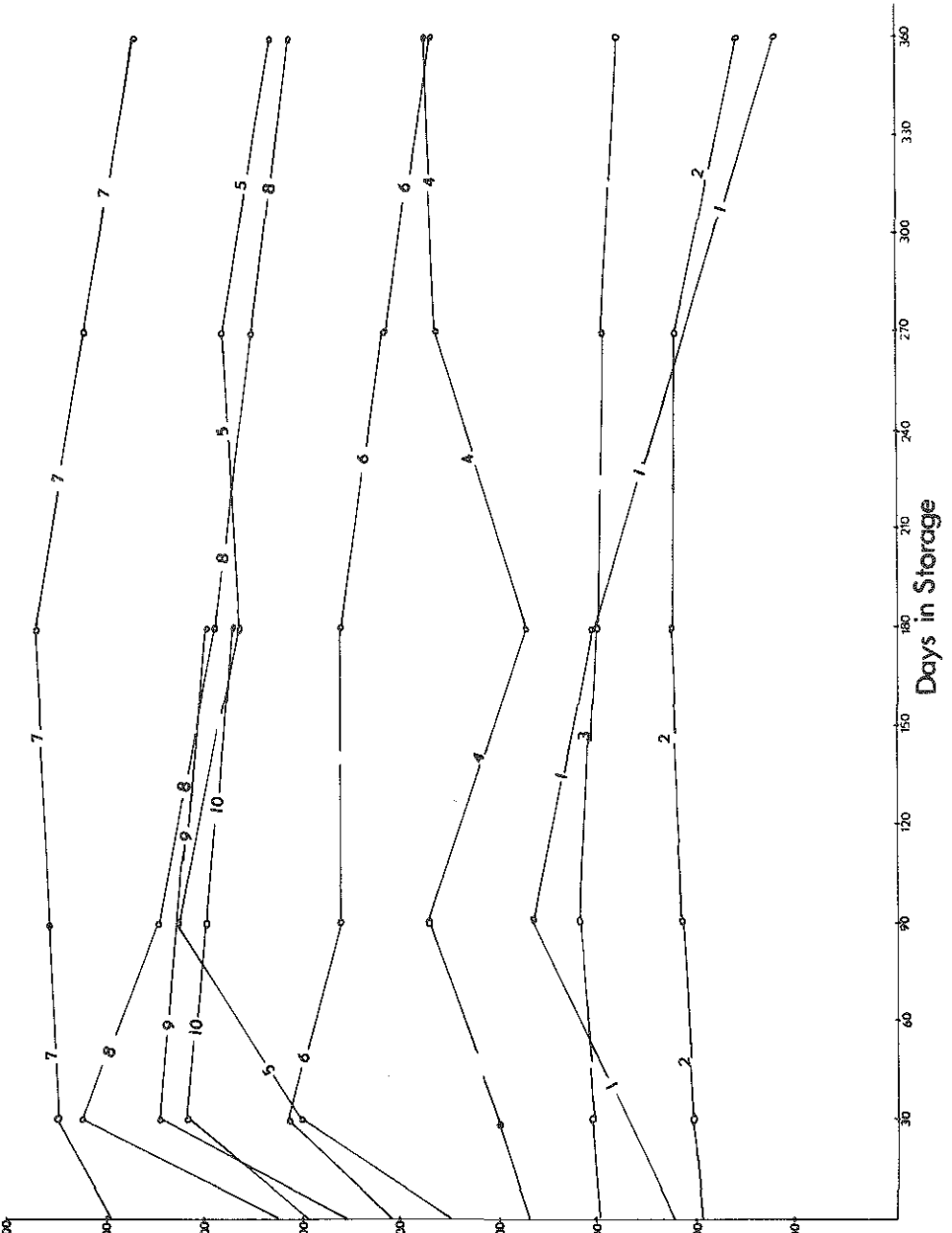

FIG. 2.—Changes in green pigment in candied citron prepared from frozen pulp.

espacio de almacenamiento; ocasiona altos gastos en transportación y requiere un uso excesivo de sal. Se estudió la posibilidad de congelarla picada en cubitos de 1/4 de pulgada luego de tratarla con agua a 170° F (76.7° C), con y sin $CaCl_2$, por períodos de 1/2, 1, 2 y 3 minutos.

Los estudios de los azúcares, la textura y pérdida del color verde se llevaron a cabo por un año con muestras endulzadas de cada tratamiento y del control, el cual se hizo por el método estándar de fermentación de la fruta fresca. Se encontró que los azúcares reductores aumentan con el tiempo. El aumento mayor lo tuvo la muestra congelada sin escaldar. El cambio en las muestras escaldadas, independientemente del tiempo transcurrido fue similar al obtenido en la muestra fermentada sin congelar. Los estudios de textura con la prensa Allo-Kramer demostraron que la escaldadura por 1/2 m en agua a 170° F (76.7° C) produce una cidra similar o mejor en textura que la que se obtiene con el método corriente de fermentación en salmuera. Prolongando la escaldadura y añadiéndole $CaCl_2$, se obtienen cubitos de textura más dura que los obtenidos por fermentación de la fruta fresca. Con todos los tratamientos, excepto con los escaldados por 3 minutos, con y sin $CaCl_2$, y con la fruta congelada sin tratamiento alguno se obtuvo el verde más intenso. El color verde palidece mucho durante los primeros 3 meses, pero aún más en los casos ya mencionados.

Con una escaldadura por 1/2 m con agua a 170° F (76.7° C) la cidra puede congelarse y obtener cubitos de cidra endulzada de características similares a la obtenida por métodos tradicionales. A la vez requiere menos sal, reduce el espacio de almacenamiento y cuesta menos transportarla.

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