Studies on the Stability of Vitamin C at Elevated Concentrations in Canned Tropical Fruit Juices and Nectars

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INTRODUCTION

Ascorbic acid (vitamin C) through its ability to accept oxygen from the air, can delay the usual oxidation process of foodstuffs. It can be a synergist to primary antioxidants in the role of a hydrogen donor. It can serve at times as an enzyme substrate where enzymatic oxidation is involved.

Although previous work has demonstrated many practical uses for this nutritionally acceptable chemical compound, more applied research is necessary to evaluate its commercial role, especially in the fortification of processed foods and drinks.

The studies on the stability of vitamin C in fruit juices and nectars at elevated levels are a step in this direction. Although it may be said that it is economically, practically, and nutritionally feasible to add ascorbic acid to fruit and vegetable juices to standardize their vitamin C potency, the level of enrichment also needs to be considered (*1*)[2]. Siemers (*2*) indicated that, in vitamin enrichment of any fruit juice, the addition should supply in an average serving the quantity of the vitamin usually found in the same amount of other juices considered good sources for the vitamin. However Moscoso (*3*) reported that acerolas (West Indian cherries) yield from 1,000 to 4,000 mg. of ascorbic acid per 100 gm. of edible matter. Acerola is a potential source of natural vitamin C which can be exploited to great advantage by canning and other processing industries.

Rahman (*4*) showed that the percentage of vitamin C losses in tropical fruit juices and nectars fortified with 10 to 4,000 mg. per 100 ml. are not proportional to concentration. Esselen *et al.* (*5*) reported that added ascorbic acid in fortified juices was well retained during processing and storage at room temperature. Johnston (*6*) concluded that small losses of ascorbic acid are to be expected in any ordinary process of making fortified apple juice. Somewhat larger losses will occur over an extended period of storage at room temperature. Popov and Osterov (*7*) stated that studies on 130 healthy young subjects who spent 6 to 30 months in the Arctic, and received 100 to 150 mg. of vitamin C daily, indicated that vitamin C in blood serum

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[2] Italic numbers in parentheses refer to Literature Cited, pp. 335–6.

did not reach the desired standard of 1.5. They recommended that men doing physical work should receive 250 to 300 mg. daily in the Arctic.

PROCEDURE

Canned juices of orange, pineapple, and tomato were purchased from the local market, whereas canned guava nectar was obtained from the

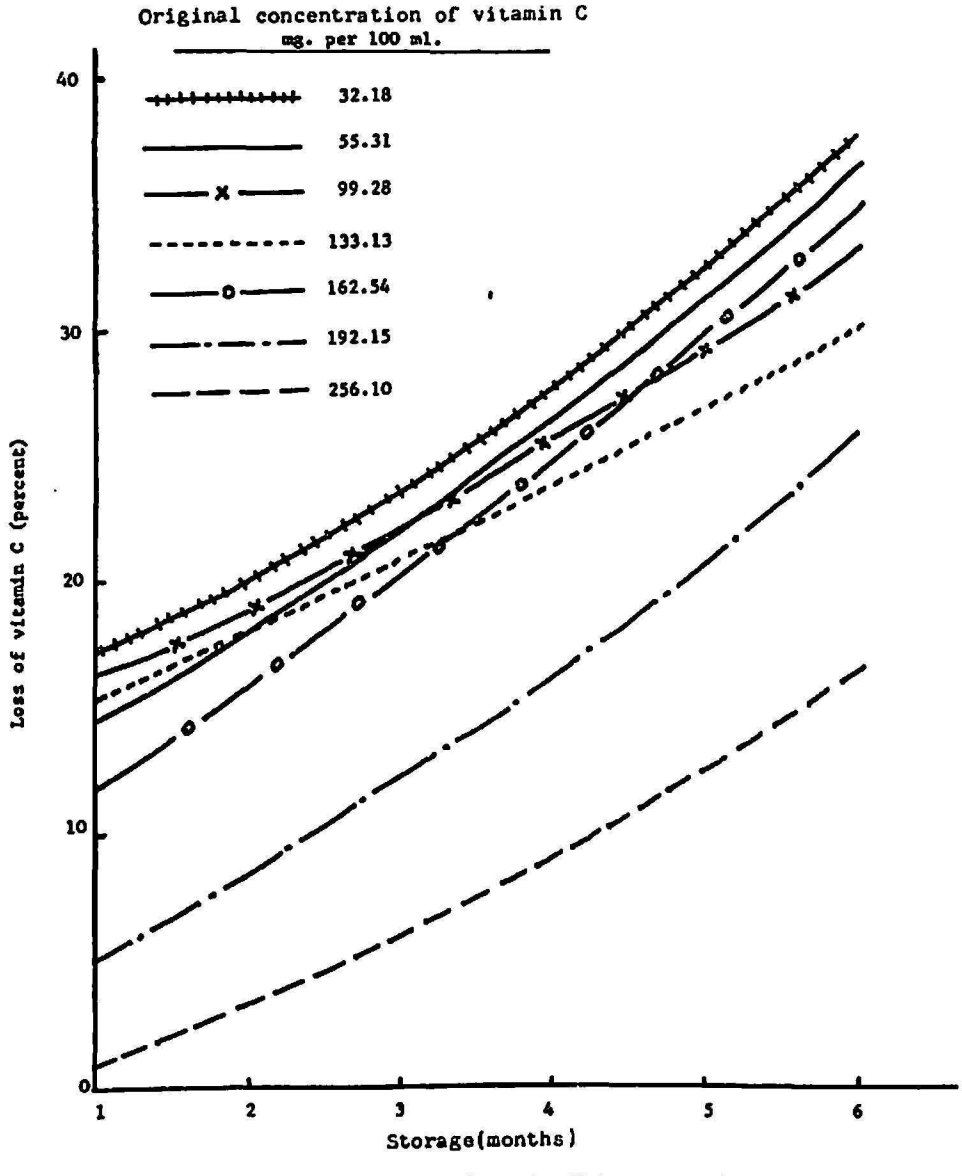

FIG. 1.—The trend of destruction of vitamin C in canned guava nectar stored for 6 months at room temperature.

Food Technology Laboratory of the Agricultural Experiment Station of the University of Puerto Rico. The contents of the cans of each juice or nectar were transferred into separate containers. The quantity of each sample was divided into seven equal parts which were fortified with ascorbic acid at different levels, ranging from the original contents to about 300 mg. per 100 ml. Each sample was immediately packed in 8-ounce tin cans

following the conventional method of canning. Vitamin C was determined immediately after the canning at each level of fortification. The cans were identically divided into two parts where one was stored at room temperature

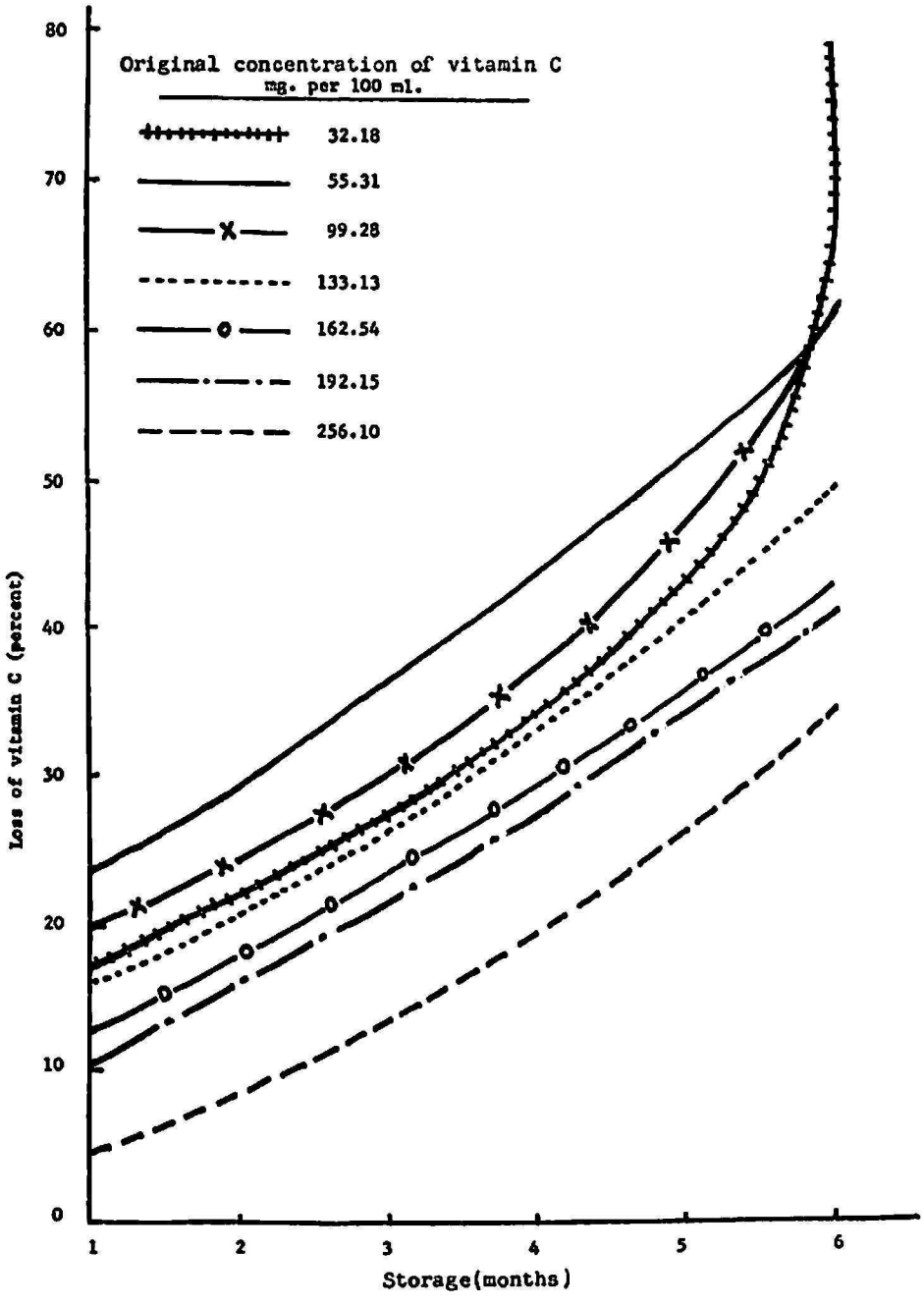

FIG. 2.—The trend of destruction of vitamin C in canned guava nectar stored for 6 months at 100°F.

and the other at 100°F for a period of 6 months. The vitamin C was determined at the end of each month.

The chemical analyses of vitamin C were made by the iodate method as modified by Ballentine (*8*). All the analyses were determined in duplicate and then averaged.

RESULTS AND DISCUSSION

The results of the effect of storage at room temperature as well as at 100°F. on guava nectar containing different amounts of vitamin C are shown in figures 1 and 2. More vitamin C was lost in nectars stored at 100°F. at all levels of concentrations than from those stored at room temperature.

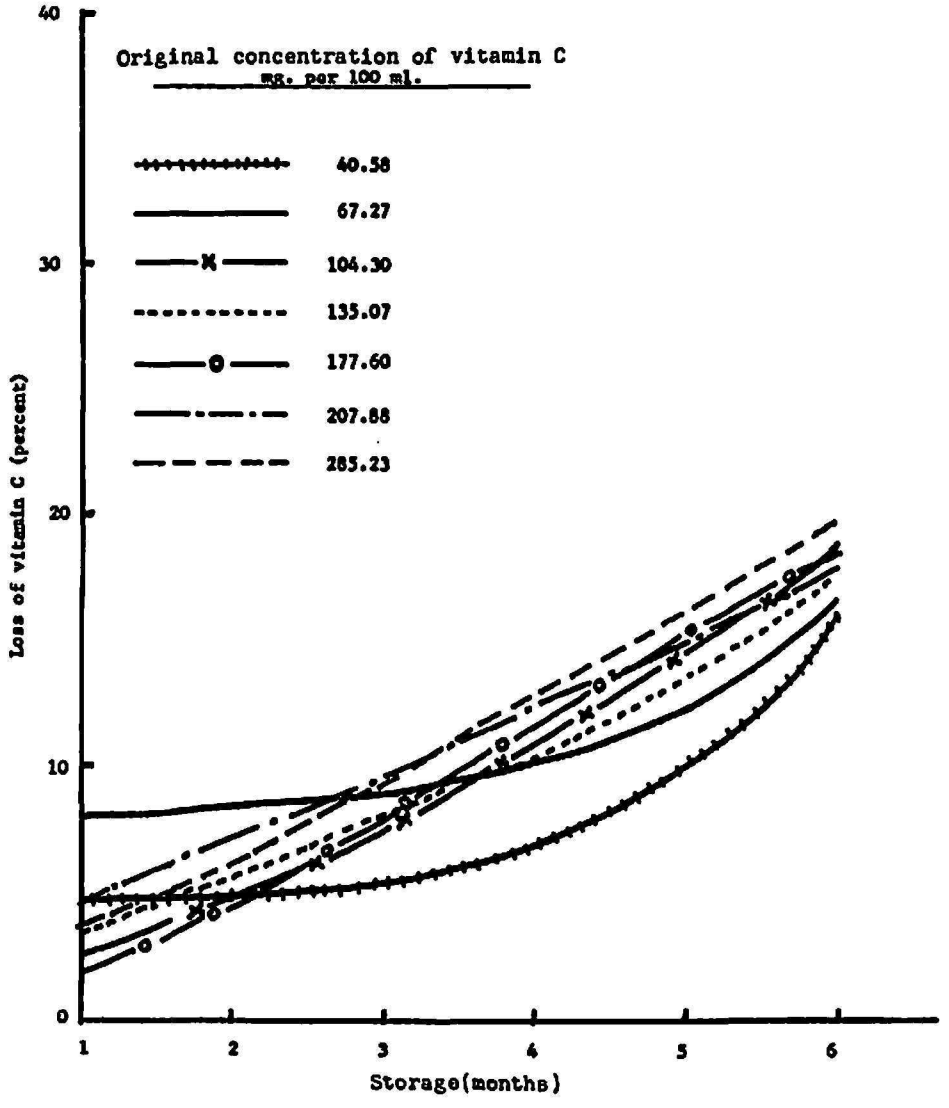

FIG. 3.—The rate of destruction of vitamin C in canned orange juice as affected by storage for 6 months at room temperature.

However, the trend of destruction was relatively higher, the lower the concentration of vitamin C. This indicates that vitamin C is relatively more stable at higher concentrations. Figures 3 and 4 show that the destruction of vitamin C at all levels of concentration in orange juice stored at room temperature was below 30 percent. However, the trend of destruction did not follow a definite pattern with relation to the levels of concentration. Somewhat similar results were obtained for the pineapple juice, as indicated in figures 5 and 6, as well as in tomato juice as indicated in figures 7

and 8. This shows that the destruction of vitamin C was not proportional to its concentration.

Studies of this nature could be helpful in some areas in the food industry where fortification with vitamin C at elevated levels is recommended.

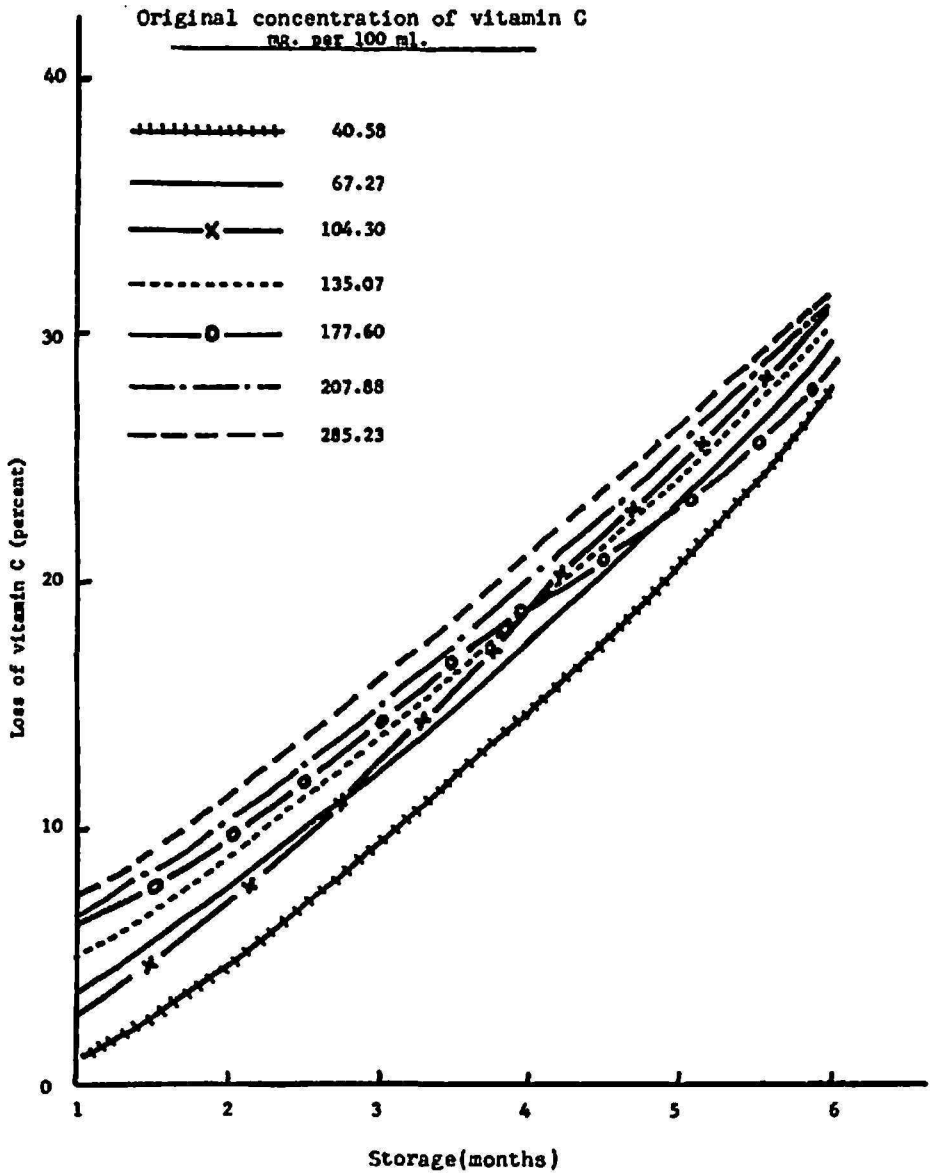

FIG. 4.—The rate of destruction of vitamin C in canned orange juice as affected by storage for 6 months at 100°F.

On the other hand, more basic research is needed to assure better understanding of the nature and behavior of this vitamin, especially when it is at higher levels of concentrations in processed foods.

SUMMARY

Studies were conducted to determine the stability of vitamin C at elevated concentrations in canned tropical fruit juices and nectars. Canned

guava nectar, as well as juices of orange, tomato, and pineapple were fortified with ascorbic acid at seven different levels ranging from the original content present in the samples to about 300 mg. per 100 ml. Half of the samples were stored at room temperature and the other similar half at 100°F. for a period of 6 months. The results indicated that the losses of

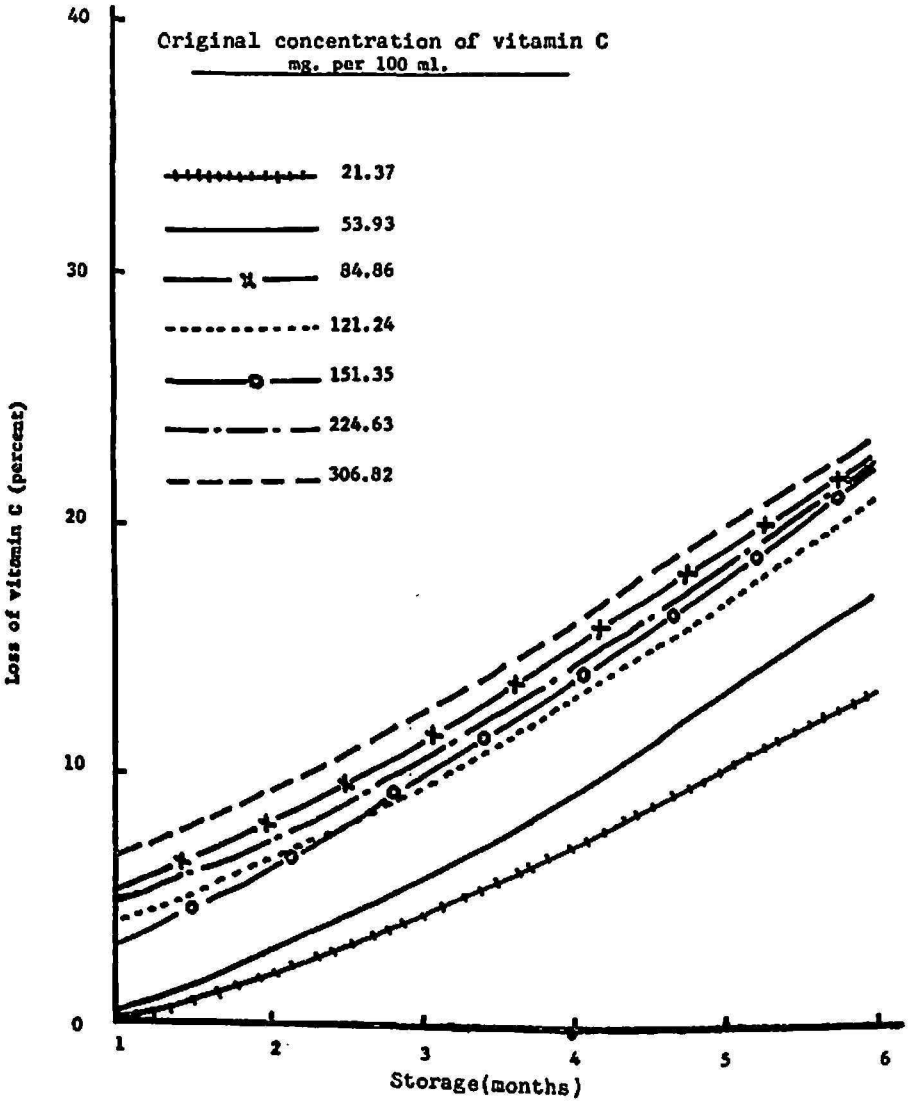

FIG. 5.—The effect of storage for 6 months at room temperature on the stability of vitamin C in canned pineapple juice.

vitamin C were higher in the samples stored at 100°F. than in those stored at room temperature—regardless of the level of concentration. However, in the guava nectar the percentage of vitamin C destruction was relatively higher at lower concentrations and lower at higher concentrations at both temperatures. No such pattern could be observed in the juices.

But the losses of vitamin C in the juices at all levels of concentration ranged below 30 percent at room temperature and below 40 percent at

100°F. This is relatively less than the losses that occurred in the guava nectar.

RESUMEN

Se estudió la estabilidad de la vitamina C añadida en altas concentraciones a jugos y néctares de frutas tropicales envasados. Muestras de

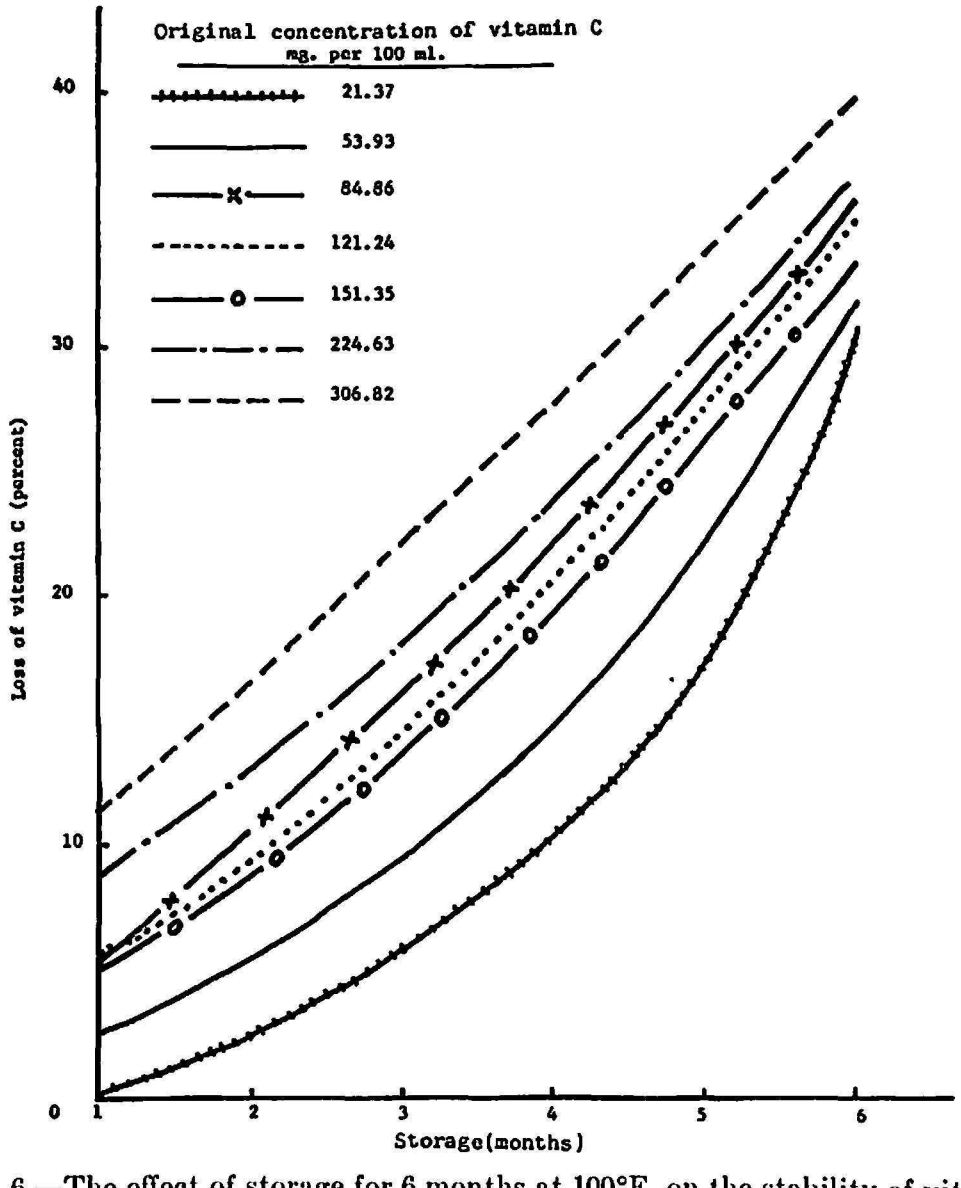

FIG. 6.—The effect of storage for 6 months at 100°F. on the stability of vitamin C in canned pineapple juice.

néctares de guayaba enlatados, así como también, jugos de china o naranja, jugos de tomate y jugo de piña se enriquecieron con ácido ascórbico en siete niveles diferentes donde las concentraciones variaron desde el contenido de vitaminas original en las muestras hasta 300 mg. por cada 100 ml. del producto enlatado. Las muestras se almacenaron y se observaron

por un período de 6 meses bajo dos condiciones de temperatura distintas: unas a temperatura de ambiente y otras a 100°F.

Los resultados obtenidos indicaron que las pérdidas de la vitamina C en las muestras, en todo los niveles de enriquecimiento, almacenadas a

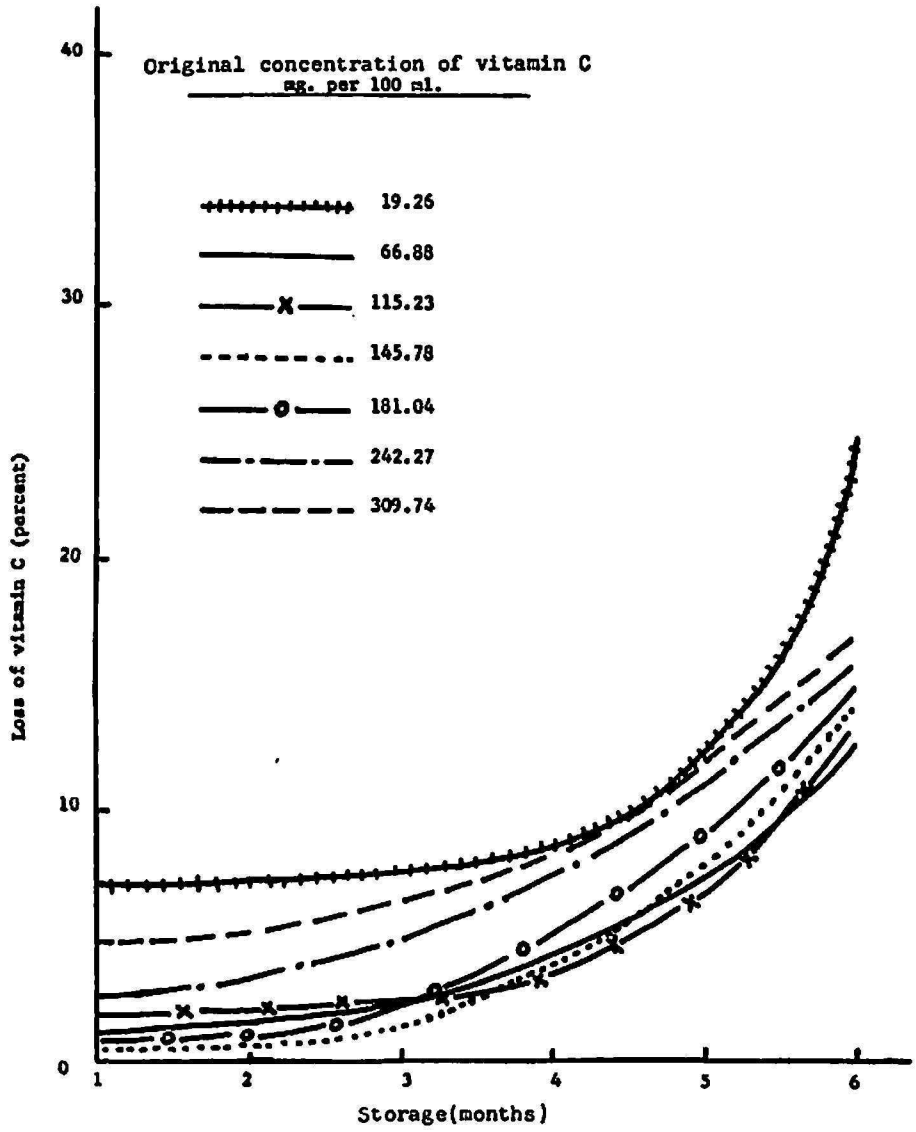

FIG. 7.—The trend of destruction of vitamin C in canned tomato juice as affected by storage for 6 months at room temperature.

100°F. fueron mayores que las pérdidas registradas en las muestras a temperatura de ambiente. El porcentaje de destrucción de la vitamina en el néctar de guayaba fue relativamente más alto a concentraciones bajas que a concentraciones altas en ambas condiciones del almacenamiento. Sin embargo, no pudo observarse este mismo patrón en el caso de los jugos. Las pérdidas de la vitamina C en estos fué menor del 30 porcentaje para las muestras a temperatura de ambiente y menor del 40 por ciento para

las muestras a 100°F. en todos los niveles de ácido ascórbico. Las pérdidas de vitamina anotadas en el caso de los jugos fueron relativamente menores que las observadas para el néctar de guayaba.

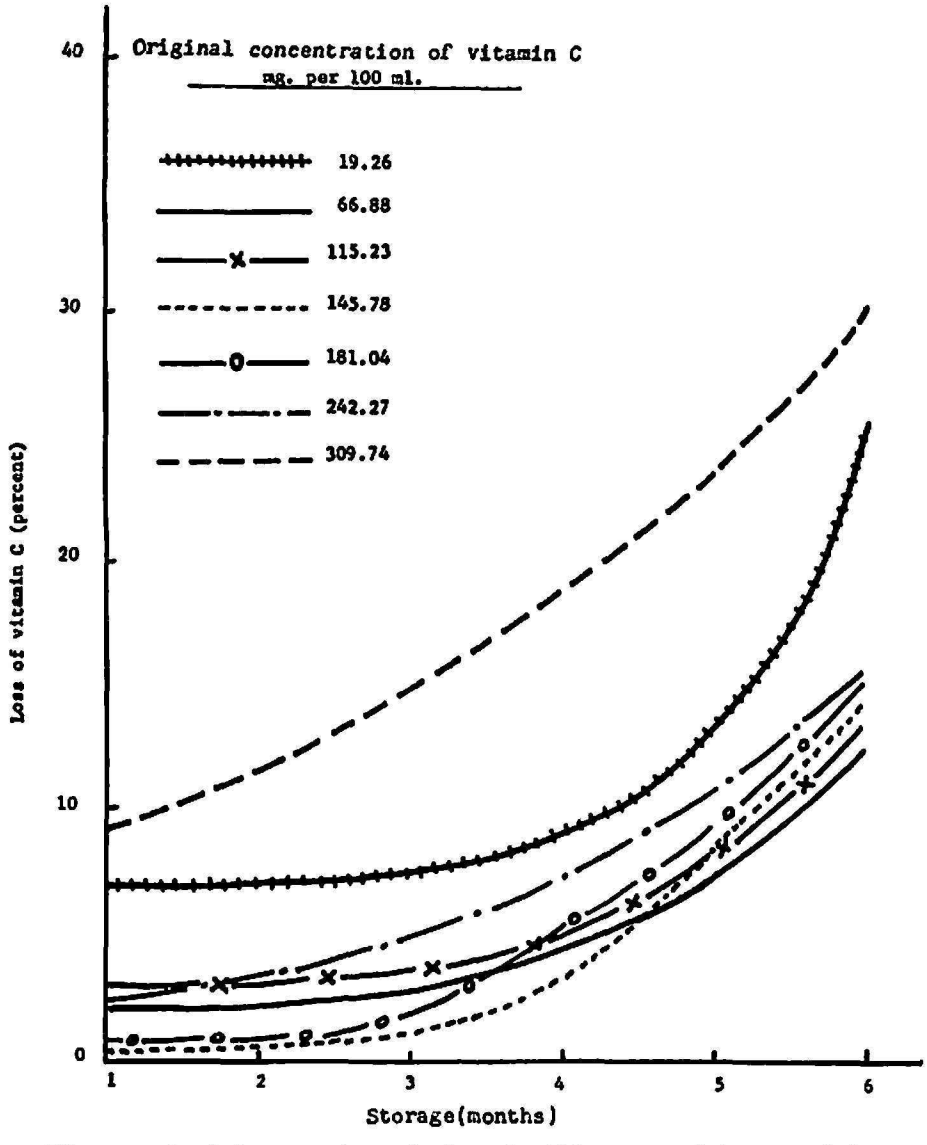

FIG. 8.—The trend of destruction of vitamin C in canned tomato juice as affected by storage for 6 months at 100°F.

LITERATURE CITED

1. Mrak, E. M., and Stewart, G. F., Advances in Food Research, vol. 4 379–80 Academic Press Inc., New York, N.Y. 1953.
2. Siemers, G. F., Processing of vitamin C (ascorbic acid) enriched apple juice, *Glass Packer* **25** (8), 612–3, 1946.
3. Moscoso, C. G., West Indian Cherry, richest known source of natural vitamin C, *Econo. Bot.* **10** (3) 280–94, 1956.
4. Rahman, A. R., Anziani J, and Cruz-Cay, J. R., Factors affecting the stability of vitamin C in tropical fruit juices and nectars, *J. Agr. Univ. P.R.* **48** (1) 1–12, 1964.

5. Esselen, W. B., Jr., Powers, J. J., and Fellers, C. R., The fortification of fruit juices with ascorbic acid. *Fruit Prod. J.* **26** 11–4, 1946.
6. Johnston, F. B., Vitamin C fortification of apple juice, *Fruit Prod. J.* **22** 195–7, 1943.
7. Popov, V. A., and Osterov, G. A., Vitamin C content of blood of healthy persons and some surgical patients in the Arctic, *Vop. Pitan* **21** (6) 60–2, 1962.
8. Ballentine, R., Determination of ascorbic acid in citrus juices, *Ind. Eng. Chem.* Anal. Ed. 13 89–90, 1941.