THE PREPARATION AND STORAGE PROPERTIES OF CANNED GUWAYABANO (ANONA MURICATA L.) CONCENTRATE

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ONE TEXT FIGURE

Fruit juice concentrates are gaining increased importance in the fruit preservation industry, since they reduce packaging, transport and storage costs. They also have the added advantage of convenience for use in the homes, in institution, and in the remanufacturing trade.

A tropical fruit and a native of tropical America, *Guwayabano* or soursop (*Anona muricata* L.) was introduced at an early date into the Philippines where it is grown in all parts of the archipelago.(2) The fruit is most abundant during the rainy season, from June to August. It is green and pear-shaped with spines, and its fleshy pulp, which is white, soft and rather fibrous, has an agreeable flavor, although rather sour. It is generally eaten raw and, on a limited scale, it is used for flavoring ice creams. Recently, the pilot food plant of the University of the Philippines, Diliman, Quezon City, produced canned guwayabano juice in commercial quantities. The estimated local annual production of the fruit in 1963 was 5 million kilograms.(23)

REVIEW OF LITERATURE

The preparation of fruit juice concentrates has been the subject of intensive studies. The pilot plant scale preparation of juice concentrates from cashew apple, passion fruit, Valencia orange and lemon in forced circulation falling-film evaporator has been reported by Pruthi, et al.(16,17,18,19) The preparation of high-density full-flavor grape juice concentrate,(9) peach concentrate,(7) apple concentrate(8) and berry juice concentrate(6) by vacuum evaporation has also been done in the Eastern Utilization Research Branch of the U. S. Department

of Agriculture. The preparation of juice concentrates from strawberry, apple, and prune has also been conducted by Walker, et al.(24, 25, 26) Since practically all of the volatile flavoring constituents in fruit juices are lost during vacuum concentration, the stripping and recovery of the volatile flavors and their subsequent restoration to the concentrates have also been studied.(3, 11, 14, 20, 27) Pruthi,(25) for one, studied the restoration of volatile flavors in orange concentrate lost during concentration with the use of orange oil or freshly extracted juice for the purpose.

The concentration of fruit juices by freezing has also been studied.(12) Soliven, et al.(22) investigated the preparation of kalamansi (*Citrus nobilis* L.) juice concentrate through freezing. The concentrate retained a high percentage of volatile flavors. However, no practical equipment for freeze-concentration has yet proved entirely satisfactory for its commercial use.

The study was undertaken to apply the "cut-back" principle of fruit-juice concentration without the use of specialized essence-recovery units in the laboratory, and to study the storage properties of the product obtained. The "cut-back" method consists in adding some fresh juice to the concentrate at the time of manufacture to partially restore fresh flavor lost during the concentration process. Soursop was chosen for the method, because of its pleasant, characteristic flavor, which remained quite stable even upon the application of heat, and because of its wide availability in the country.

EXPERIMENTAL PROCEDURE

Soursop juice concentrate was prepared by the following procedure.

Fully ripe, sound fruits were thoroughly washed with detergent, then carefully rinsed in running water. The fruits were cut into halves and the pulp was separated from the skin. The seeds were removed. Water was added to the pulp in a 2:1 ratio. The mixture was blended in a Waring blendor to facilitate juice extraction and then strained through a muslin bag. The clear juice was concentrated in a laboratory vacuum evaporator operating at 25 to 27 inches vacuum and 30-lbs./sq. in. steam pressure. The juice was fed at 4°Brix and concentrated to about 6-fold, i.e. 25°Brix. The concentrated juice was "cut-back" to 16°Brix with freshly prepared juice. Ascorbic acid equivalent to 50 mg/100 cc was added

during the pasteurization process. The fortified concentrate was pasteurized at 85°C for 5 minutes, hot-filled into previously sterilized cans, sealed completely and processed in boiling water for 10 minutes. The cans were immediately cooled under running water, wiped dry and divided into 2 lots. One lot was stored at room temperature (29° to 31°C) and the other, in a household refrigerator (4° to 5°C) for storage studies.

EXAMINATION OF JUICES

Ascorbic acid determination of the fresh juice and the juice concentrate before and after fortification was done using the indophenol titration method.(1) The stored products were likewise analyzed for ascorbic acid content at regular intervals of 2 months, starting from the freshly prepared product up to 12 months thereafter.

Titratable acidity (expressed as per cent anhydrous citric acid) was determined on the fresh juice and on the concentrate before and after fortification by titration with 0.1 N sodium hydroxide using phenolpthalein as indicator. The pH values of the same samples were measured with the use of a Beckman pH meter. The total soluble solids, expressed in degrees Brix, were taken with the use of Zeiss-Opton hand refractometer.

Color determination were made on the fresh and stored concentrates with the use of a Klett-Summerson photoelectric colorimeter. An aliquot portion of each sample was centrifuged for 20 minutes until a clear supernatant liquid was obtained. The clear liquid was carefully decanted and diluted to an appropriate concentration (1°Brix) with distilled water so that light transmittance characteristics could be read, with the use of a standard red filter (No. 64) which had an approximate spectral range of 600 to 670 millimicrons. Scale reading, proportional to absorbance or optical density, was used as an index of color or darkness.

Evaluation of palatability and physical appearance through eye appeal of the fresh and stored concentrates after reconstitution was undertaken by a panel of tasters of the Family Nutrition Branch, Medical and Applied Nutrition Division of the Food and Nutrition Research Center. The panel was made up of 12 technical personnel, and evaluation was done either at midmorning (9:30 a.m.) or at midafternoon (3 p.m.). The hedonic scale method developed by Peryam and

Girardot(13) was used. The following criteria for scoring as to eye appeal (color, attractiveness) and palatability (odor, taste) were used:

9. Like extremely
8. Like very much
7. Like moderately
6. Like slightly
5. Neither like or dislike
4. Dislike slightly
3. Dislike moderately
2. Dislike very much
1. Dislike extremely

The juice concentrates were diluted with two parts of water per part of concentrate, with sugar added to taste, to give a reconstituted juice with 13 to 14°Brix-reading before being presented to the panel.

RESULTS AND DISCUSSION

Table 1 shows the results of the physical and chemical analyses of *guwayabano* juice before and after concentration and fortification. The pH of the juice changed for 3.35 before concentration to 3.31 after concentration and fortification. The acidity of the fresh juice was 0.36 per cent; after concentration, 0.94 per cent; and after fortification, 1.12 per cent. Ascorbic acid was added to the concentrate mainly to retard normal oxidative browning, which occurs on storage, and to increase the vitamin C level of the product. Curl(4) and Dryden, et al.(5) reported that nonenzymatic browning markedly increases with increase in concentration especially at elevated temperatures. This change is readily seen in light-colored juices. Loss of ascorbic acid during concentration, equivalent to 33 per cent, may be due to evaporation losses carried over with the distillate.

TABLE 1.—*Physical and chemical analyses of guwayabano juice before and after concentration and fortification with vitamin C.*

Physico-chemical characteristics	Before concentration	After concentration	After fortification 50 mg/100 cc)
°Brix	4.0	16.0	16.0
pH	3.35	3.2	3.1
Acidity (per cent citric acid)	0.36	0.94	1.12
Ascorbic acid, (mg/100 cc)	4.55	12.13	59.75
Ascorbic acid retention (per cent)		66.65	96.17

Table 2 presents data on the percentage retention of ascorbic acid in the fortified concentrates on storage at two ranges of temperature, i.e., room temperature and refrigerated tempera-

ture. Ascorbic acid retention at refrigerated storage and room temperature storage ranged from 95 to 90 per cent and from 92 to 54 per cent, respectively, after 12 months. Initial ascorbic acid content of the stored concentrates was 59.75 mg per cent. This result is in agreement with the report of other investigators (4, 20, 21) who have reported that the rate of as-

TABLE 2.—*Ascorbic acid contents of guwayabano concentrates stored at two ranges of temperature and corresponding percentage retention.*

Length of storage (months)	Refrigerated temperature		Room temperature	
	Ascorbic acid	Retention	Ascorbic acid	Retention
	mg per cent	*Per cent*	*mg per cent*	*Per cent*
0	59.75		59.75	
2	56.88	95.20	54.75	91.63
4	56.50	94.56	50.00	83.68
6	55.82	93.42	46.37	77.61
8	53.13	88.52	39.24	65.67
10	52.83	88.42	35.01	58.69
12	53.78	90.01	32.24	53.96

corbic acid loss in fruit juices is a function of storage time and temperature. Figure 1 is a graphical representation of the changes in ascorbic acid content of the stored concentrate up to 12 months of storage. Ascorbic acid content of the refrigerated concentrates ranged from 57 to 54 per cent after 12 months of storage and those stored at room temperature ranged from 55 to 32 per cent after the same storage period.

Evaluation of the stored concentrates for acceptability upon reconstitution indicated that there was no significant difference in the mean scores for palatability and eye appeal at 5 per cent level between the freshly prepared fortified concentrate and those stored in the refrigerator and at room temperature even after 12 months of storage (Table 3). It can be fairly concluded that canned soursop concentrate has excellent storage properties even at room temperature, as far as acceptability is concerned. The addition of ascorbic acid may have contributed, in one way or another, to the prevention or retardation of off-flavor development in the juice, as shown in the studies of Esselen, et al. (10) on some fruit juices.

Effect of storage on the optical densities of the *guwayabano* concentrates is shown in Table 4. In general, it appears that storage at room temperature enhanced darkening of the product.

Visual observation showed color change in the concentrate stored at room temperature, which was easily detectable by the naked eye after 6 months of storage. Visual change in the refrigerated samples was hardly noticeable even after 12 months of storage. It should be noted that the optical density decreased

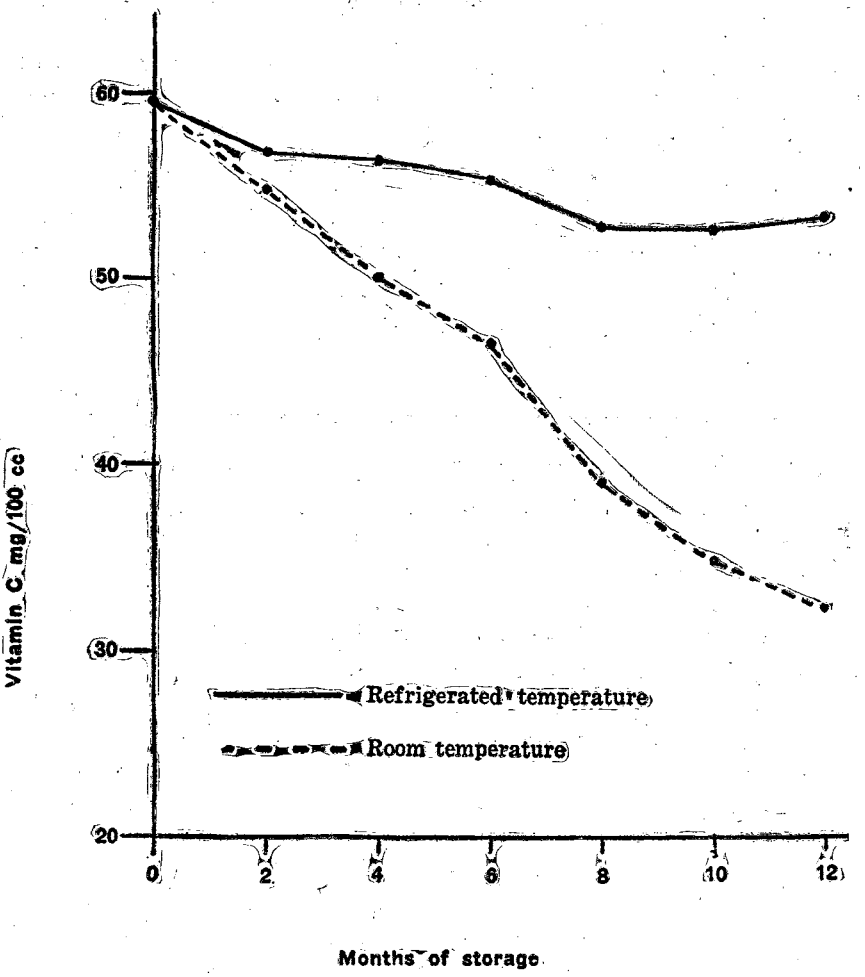

FIG. 1. Effect of length and temperature on vitamin C content of guwayabano concentrate.

on storage at both ranges or temperature up to 2 months, then increased thereafter till the 12th month of storage, especially at room temperature. Probably the bleaching action of added ascorbic acid checked browning-up to the 2nd month, but it

was off-set at high temperatures on further storage as shown by the sudden rise in optical density of the samples stored at room temperature from the 4th month of storage onwards up to the 12th month. The bleaching effect of ascorbic acid has been attributed to its reducing action.(5,10) The rate of darkening of the stored juices is more or less related to the loss of ascorbic acid. The greater the loss of ascorbic acid, the faster the rate of darkening.

TABLE 3.—*Mean scores on eye appeal and palatability of guwayabano concentrate stored at two ranges of temperature up to 12 months of storage.**

Lenght of storage (months)	Eye appeal		Palatability	
0	6.75±0.22		7.33±0.28	
	Refrigerated temperature	Room temperature	Refrigerated temperature	Room temperature
2	7.00±0.20	6.58±0.19	7.08±0.23	6.41±0.34
4	6.75±0.13	6.75±0.18	6.42±0.42	6.42±0.29
6	6.33±0.43	6.58±0.29	6.58±0.22	6.75±0.13
8	7.00±0.21	7.00±0.17	7.17±0.32	6.83±0.11
10	6.92±0.38	6.58±0.47	7.08±0.15	6.50±0.47
12	6.58±0.38	6.50±0.43	7.17±0.53	6.75±0.26

* Evaluations were done either at midmorning or midafternoon by 12 panel members (6 males and 6 females).

TABLE 4.—*Optical density of guwayabano concentrate as effected by storage.*

Length of storage (months)	Room temperature 29° to 31° C	Refrigerated 4° to 5° C
0	0.39	0.39
2	0.26	0.33
4	0.39	0.39
6	0.46	0.38
8	0.63	0.44
10	0.80	0.48
12	0.90	0.49

SUMMARY AND CONCLUSION

Guwayabano (*Anona muricata* L.) or soursop concentrate of 16°Brix was prepared by vacuum concentration in a vacuum evaporator. The concentrate was fortified with ascorbic acid equivalent to 50 mg/100 cc of its total volume. The canned products were stored at two ranges of temperature; namely, room temperature (29° to 31°C) and refrigerated temperature

(4° to 5°C) for 1 year. Periodic determinations of ascorbic acid, color, and acceptability in terms of flavor and eye appeal were made.

Storage at refrigerated temperature favored better retention of vitamin C and retarded the rate of color darkening in the stored concentrates.

There were no significant differences at 5 per cent level in mean scores of flavor and eye appeal of soursop concentrate stored at room temperature and in the refrigerator up to 12 months of storage.

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