RESEARCH NOTE

STABILITY OF ASCORBIC ACID IN ORANGE JUICES AFTER INITIAL USE AT HOME BEGINS

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ABSTRACT

Ascorbic acid (AA) stability in orange juices, both fresh and commercially packaged in different types of containers (Tetrabrik, glass and tin), was studied. The purpose was to ascertain how well AA is retained once use at home has commenced. The AA levels of the orange juices were measured at 0, 1, 3, 5, 67, 24, 48, 72 and 168h following squeezing in the case of fresh oranges and for commercially packaged juices following opening of the container. Storage was at 4 or 25C. Fresh juice was stored in an open jar; packaged juice in the container in which it came. When stored 7 days at 4C, retention ranged from 93.8 to 95%.

INTRODUCTION

The main sources of vitamin C in Spanish diets are fruits and vegetables. Among the former, citrus fruits stand out for their high content and, especially in the case of oranges, are a normal component of the diet.

Given the fact that the recommended vitamin C intake for adults is 60 mg/day (RDA 1990) and the estimated mean content in just-squeezed orange juice can be 52.9 mg/100mL (the value found in this study), 100mL of juice can furnish the amount needed to meet the requirement.

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In an aerobic atmosphere ascorbic acid (AA) oxidizes first to dehydroascorbic and then to 2,3-diketogulonic acid and loses its vitamin activity in the process. pH has an influence on oxidation, which is greatest at pH 5 - 11.5 (Blaug and Hajratwala 1972; Hurt 1979; Leon *et al* 1982). Temperature has been reported to be the most critical factor in preserving ascorbic acid (Nagy and Smoot 1977). In solutions and even in the dry pure state, AA has been demonstrated to degrade with time (Kennedy *et al* 1989). In fact, AA content is used to estimate the mean life of several products, as a parameter for evaluating the preservation of vitamin content and other components responsible for the organoleptic characteristics of fruit and vegetable preserves (Ashoor *et al* 1984; Klein *et al* 1981; Laing *et al* 1978; Lathrop and Leung 1980; Paulus 1989; Rizzolo *et al* 1984).

In order to facilitate juice preservation and distribution, the common technological practice is to package fruit juices. Recent changes in packaging include the use of glass, polyethylene, polystyrene, cardboard, plastic and foil laminates, as well as aluminum and tin coated steel cans for various citrus products. Some authors have raised the question of whether AA retention is affected by the type of container used to store reconstituted orange juice at home and by in-home storage time before use (Bisset and Berry 1975).

The objective of this work was to study, under household conditions, the AA stability of orange juices, both fresh and commercially packaged in different types of containers. For this purpose the AA content of fresh juice stored at 4 and 25C and commercial packaged juice, once the container was opened, stored at 4C was monitored over 7 days. During this period of time commercial juices were kept in the original containers and the fresh ones in a jar.

MATERIALS AND METHODS

Samples

All juice samples were bought from local grocers and supermarkets. Fresh juices (n=2): Immediately after squeezing the orange juices were stored in a refrigerator (4C).

COMMERCIAL JUICES (N=7): Once opened the containers were stored at 4C (refrigerator) for the duration of the trail. Sample 3 was pasteurized orange juice (Tetrabrik container); sample 4 pasteurized orange juice (glass container); sample 5 juice obtained from orange concentrate (tin can): sample 6 juice obtained from orange concentrate (Tetrabrik container); sample 7 orange nectar -minimum 4% juice (glass container); sample 8 orange nectar minimum 40% juice (tin container); sample 9 orange soft drink without carbonation minimum, 25% juice Tetrabrik container).

Apparatus and Reagents

A polarograph Methrom with a basic 663-VA Stand, and operational control unit 626 Polarecord, without integrator was used for the determinations; pH meter Crison Digilab 517; folded filters Whatman No. 1, 110mm diameter.

Acetic acid, oxalic acid, trichloroacetic acid, sodium acetate and disodium sulfate regents were all of analytical grade, and water was distilled-deionized.

The AA standard was obtained from Merck with a purity of 99.7%.

Method

Sample Preparation. Juices squeezed mechanically were homogenized by shaking. A 5 mL aliquot was diluted to 25mL with the extraction solution (Oxalic acid 1% W/V/ trichloroacetic acid 2% W/V sodium sulfate 1% W/V/. After vigorous shaking the solution was filtered through a folded filter (Whatman No. 1.). The 9.5 mL of oxalic acid 1% W/V and 2 mL of an acetic acid/sodium acetate 2M buffer (pH=4.8) were added to an aliquot of 0.5 mL of filtrate and the solution transferred to the polarographic cell. The following instrumental conditions were applied: DP50, mode DME, drop size 2, drop time 1s, scan rate 10mV/s/damp 1, initial potential - 0.10V.

Determinations were carried out by using the peak heights and standard additions method. The standards added ranged from 5 to 15 μg. Two replicates of each sample were analyzed.

RESULTS AND DISCUSSION

The AA contents of natural juice maintained at room temperature (sample 1) and refrigerated (Sample 2), at different times after squeezing are shown in Table 1. The samples kept at 25C showed evidence of fermentation after 2-3 days of storage. The results obtained indicated that after 6 h storage at room temperature 90% of the original AA still remained, whereas at 4C only 0.4% was lost and 95% of the AA was still present after a period of 7 days. These results are similar to those reported by Fellers (1988) who found that after a week's storage at 4.4C, 93.8 to 94.3% remained, and also to the results obtained by Cid *et al.* (1991) who found no significant differences in the AA content of fresh fruit juice newly squeezed and 4 h after squeezing, when juice was kept at 4 and 25C.

TABLE 1.
NATURAL ORANGE JUICE
Ascorbic acid content (mg/100mL) at different storage times after squeezing

Time	Mean ±σ (% Retention) 1	2
0	55.26 ± 0.22 (100)	50.54 ± 0.15 (100)
1	53.85 ± 0.14 (97.45)	–
3	52.40 ± 0.33 (94.82)	50.36 ± 2.44 (99.64)
5	50.76 ± 0.97 (91.86)	–
6	50.00 ± 0.97 (90.48)	50.33 ± 0.47 (99.58)
24	48.20 ± 3.27 (87.22)	50.22 ± 0.60 (99.45)
48	47.67 ± 2.37 (86.26)	50.08 ± 1.75 (99.09)
72	–	49.34 ± 0.14 (97.62)
168	–	48.01 ± 3.68 (94.99)

σ, standard deviation

The AA content of the commercial juices analyzed at different times after opening the package are included in Table 2. The lower contents of real juices in sample 7, 8 and 9 gives lower AA contents.

TABLE 2.
COMMERCIAL JUICES. ASCORBIC ACID CONTENT (mg/100L) AT DIFFERENT STORAGE TIMES AFTER OPENING THE CONTAINER

Time	Mean ±σ (% Retention) 3	4	5	6	7	8	9
0	47.23 ± 0.01 (100)	60.54 ± 1.29 (100)	37.78 ± 0.54 (100)	62.99 ± 0.24 (100)	14.60 ± 0.33 (100)	12.39 ± 0.30 (100)	23.74 ± 0.01 (100)
3	46.21 ± 0.87 (97.84)	–	–	–	–	–	–
6	45.45 ± 2.19 (96.23)	60.32 ± 0.25 (99.64)	36.49 ± 0.28 (96.58)	61.93 ± 1.84 (98.32)	14.41 ± 0.06 (98.70)	12.32 ± 0.26 (99.44)	23.26 ± 0.98 (97.98)
24	44.63 ± 2.09 (94.49)	59.51 ± 4.60 (98.46)	34.61 ± 3.24 (91.61)	60.85 ± 3.85 (96.60)	14.33 ± 0.47 (98.15)	11.56 ± 0.47 (93.30)	23.08 ± 0.21 (97.22)
48	43.82 ± 5.23 (92.78)	–	–	–	–	–	–
72	43.51 ± 0.55 (92.12)	59.64 ± 1.26 (98.51)	33.11 ± 0.28 (87.64)	60.42 ± 0.18 (95.92)	14.09 ± 1.35 (96.51)	11.53 ± 0.32 (93.06)	22.99 ± 0.20 (96.84)
168	43.16 ± 0.83 (91.38)	59.47 ± 0.45 (98.23)	32.27 ± 3.41 (85.42)	59.26 ± 0.71 (94.08)	13.30 ± 0.38 (91.09)	11.38 ± 0.28 (91.85)	22.73 ± 0.11 (95.75)

σ, standard deviation
3– Pasteurized orange juice (tetrabrik container); 4–Pasteurized orange juice (glass container); 5– Juice obtained from orange concentrate (tin can); 6– Juice obtained from orange concentrate (tetrabrik container); 7– Orange nectar – minimum 40% juice (glass container); 8 Orange nectar – minimum 40% juice) (tin container); 9– Orange soft drink without bubbles – minimum 25% juice (tetrabrik container).

Regression analysis applied to the loss of AA with time indicated that losses followed an exponential model ($y=Ke^{-bx}$) and the rate of degradation was significant. Samples 4, 8 and 9 were exceptions. Up to 168 h, losses appeared to be linear, but the rates of decline were not statistically significant.

After a seven-day storage period the percentage of AA retention in commercial juices is over 90%, except for sample 5 (tin can), which showed a retention percentage of about 85% on the third day. These results are slightly higher than the ones mentioned by Shaw and Moshonas (1991) who reported an average retention of 88% of the original AA after a week's storage in opened containers at typical home refrigerator temperatures. On the other hand, Nichabouri *et al* (1993) reported AA concentrations of 82-86% at 4C and 76-40% at 25C, after a 5-day storage period in an open container. These authors also observed a strong decrease in the original AA content from the first day and a stabilization thereafter on the third day.

COMMENTS

This study on the AA stability of natural and commercial orange juices kept in normal consumer conditions, makes it clear that although there are losses during storage, these were not applicable in the 7-day period under study. The study was not extended in time because it is not usual to store fresh juice and opened containers are not usually stored for long periods of time. Moreover, even before the seventh day of storage there are organoleptic changes that make the product inedible.

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