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Research Note

Influence of different postharvest treatments on nutritional quality of grapefruits

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Abstract

The effects of postharvest treatments and storage periods on ascorbic acid content were evaluated for Rouge La Toma and Ruby Red grapefruit cultivars (*Citrus paradisi* Macf.). The ascorbic acid levels in the beginning and the end of the treatments studied were not significantly different ($P > 0.05$) for most treatments. For both cultivars, at the end of the marketing conditions, the treatments involving low storage temperatures did not affect the ascorbic acid content. At the end of the marketing conditions, Rouge La Toma grapefruit had a decrease ($P < 0.01$) in ascorbic acid levels when temperature conditioning was part of the treatment. On the other hand, Ruby Red presented the same behavior when prolonged storage periods where used. It was concluded that Rouge La Toma grapefruit had a greater susceptibility to postharvest temperature conditioning than Ruby Red grapefruit relative to ascorbic acid degradation.

Keywords: Vitamin C; Nutritional quality; Grapefruit; Postharvest treatments

1. Introduction

Epidemiological evidence inversely relates fruit consumption to the risk of degenerative diseases (Hertog, Feskens, Hollman, Katan, & Kornhout, 1993; Stampfer et al., 1993; Southon, 1998; Benavente-García, Castillo, Marin, Ortuño, & Del Río, 1997; Block, 1992; Block, Patterson, & Subar, 1992). In this sense, the antioxidant properties of many fruits and vegetables are widely recognized (Gey, 1990; Ames, Shigena, & Hagen, 1993; Cao, Sofic, & Prior, 1997). Natural antioxidants found in these products include phenolics and nitrogen compounds, carotenoids and some vitamins (A, C, E and folates). Among antioxidant vitamins, vitamin C plays several roles in human health (Harris, 1996). Updated US daily requirements of vitamin C are 90 mg per day, for young women, and 75 mg per day for men (Levine, Wang, Padayatti, & Morrow, 2001). More than 90% of the vitamin C in human diets is supplied by fruits and vegetables (Wills, Wimalasiri, & Greenfield, 1984), being citrus fruits the most important sources of vitamin C because of the large quantities consumed (Benavente-García, Castillo, & Del Río, 1993; Castillo, Benavente-García, & Del Río, 1993; Del Río, Arcas, Benavente-García, Sabater, & Ortuño, 1998; Ortuño, Arcas, Benavente-García, & Del Río, 1999).

Many investigations have been made in the human health area, however, the effect of postharvest treatments and storage conditions on the vitamin C content of citrus fruit are scarce. Postharvest handling conditions, inherent to citrus's commerce, such as prolonged storage periods, high storage temperatures, low relative humidity, physical damage and chilling injury are known to induce vitamin C destruction in citrus fruits (Kader, 1988; Parviainen & Nyyssonen, 1992). Thus, the effect of these factors should be carefully studied when selecting postharvest treatments in order to preserve as much of the nutritional quality of citrus fruit as possible. Some of these postharvest handling conditions are included in this investigation in relation to Rouge La

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Toma grapefruit, a pigmented variety obtained from a natural mutation selected in Salta (northwestern province of Argentina), which is appreciated for its flavor and general appearance. Therefore, the objective of this research was to evaluate the effect of postharvest treatments and storage periods on vitamin C content in Rouge La Toma and Ruby Red grapefruit cultivars (*Citrus paradisi* Macf.).

2. Materials and methods

2.1. Plant material and postharvest treatments

Two grapefruit cultivars were used in the study: Rouge La Toma and Ruby Red (*Citrus paradisi* Macf.). Fruits were degreened with 3.5 mg/kg ethylene and 1.5 mg/kg CO_2 at 26°C and 90% relative humidity. Then, they were washed, disinfected (with sodium orthophenylphenate, SOPP), rinsed, dried, and coated (wax with 18 g/100 g of solids, and 5000 mg/kg thiabendazole). At this time the grapefruits were packed in boxes and randomly distributed among six different treatments mimicking different postharvest conditions. Treatments were combinations of: (1) conditioning: none or 7 days at 15°C; (2) Temperature during 18 days of cold storage: 2°C or 13°C; (3) Number of days at the shipment period with a temperature of 13°C: 4 or 17 days. For example, treatment 1 (T1) was the result of: (1) no conditioning, (2) 2°C at cold storage, and (3) 17 days at the shipment period, and so on for the remaining treatments listed in Fig. 1.

2.2. Sampling

Three boxes with 40 fruits each were used for the analysis of each of the six treatments. Grapefruits were sampled immediately after transportation, and marketing conditions. Ascorbic acid (AA) determination was performed on fruit juice pools. Each pool was obtained by squeezing six randomly chosen fruits. An aliquot from each pool was kept in a dark glass bottle with minimum headspace to prevent AA oxidation. Samples were kept at -18 ± 1°C until the analysis was performed. Duplicate determinations were made on three replicates from each sampling moment.

2.3. Analytical methodology

AA was determined volumetrically with the 2-6 dichloro-phenol-indophenol reagent (AOAC, 1990).

2.4. Statistical analysis

The response variable was the level of AA in the fruit. The data were analyzed as a $6 \times 4 \times 2$ factorial design. There were three replicates (boxes) on each of the 48 three-way interaction cells. Main effects were treatments (6), times (4) and cultivars (2). All two-way and the three-way interactions were included in the model. Planned linear contrasts were used to test the effects of different linear combinations of main effects and interactions (Weber & Skillings, 2000). All estimates and tests were calculated with PROC GLM procedure using SAS Version 8.0 (Cary, NC, USA).

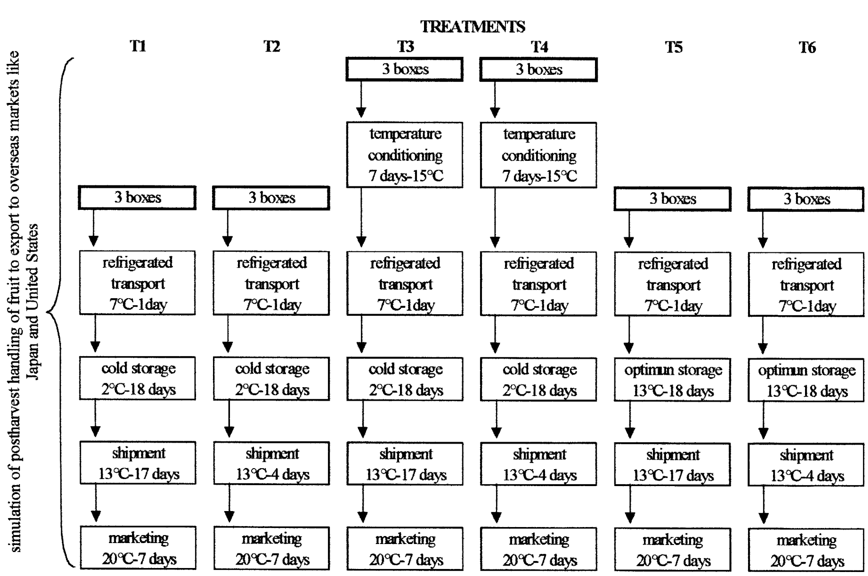

Fig. 1. Treatments simulating temperature conditioning, cold storage, shipment periods, marketing conditions and storage at optimum temperature (control treatments).