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Sensory and analytical comparison of orange-fleshed honeydew to cantaloupe and green-fleshed honeydew for fresh-cut chunks

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Abstract

Maintaining the sensory, microbial and postharvest quality of fresh-cut fruit after processing and throughout distribution and marketing is a major challenge facing the fresh-cut fruit industry. Fresh-cut chunks of orange-fleshed honeydew ('Honey Gold', 'Orange Dew', 'Temptation' and three breeding lines) and green-fleshed honeydew ('Honey Brew') and an orange-fleshed cantaloupe ('Cruiser') harvested at commercial and full-slip maturities were compared after storage for 0–11 days in air at 5 °C. Fresh-cut cantaloupe had higher respiration and ethylene production rates, aromatic volatile concentrations, and β-carotene/chroma and orange hue (except 'Orange Dew') than those of honeydew whereas honeydew chunks generally had higher soluble solids content (SSC), Kramer firmness and lower microbial counts than cantaloupe chunks. All genotypes had similar ascorbic acid levels. During storage, analytical quality characteristics of fresh-cut chunks from all genotypes were well maintained even though microbial populations increased especially on cantaloupe chunks. Consumers liked the flavor, texture, sweetness and overall eating quality of the orange-fleshed honeydew genotypes as well as or better than those of cantaloupe and green-fleshed honeydew. 'Orange Dew' scored highest in appearance and had the highest β-carotene concentration, chroma and orange hue among orange-fleshed honeydew genotypes whereas 'Temptation' generally scored highest for flavor intensity and acceptability and overall eating quality; and it had the highest aromatic volatile concentrations among the orange-fleshed honeydews. Many individual volatiles were identical in cantaloupe and honeydews; however, honeydew genotypes, particularly 'Temptation', were distinctive from cantaloupe and green-fleshed honeydew in having relatively high levels of various nonenyl and nonadienyl acetates having honeydew-like or uncharacterized aromas. Fresh-cut chunks from full-slip melons generally had higher analytical and sensory quality characteristics but higher microbial counts and lower shelf stability compared to those from commercially mature fruit. The results indicate that orange-fleshed honeydews are a promising new melon type for fresh-cut processing.

Keywords: *Cucumis melo*; Quality; Respiration and ethylene production rates; Volatiles

1. Introduction

In the past decade, fresh-cut produce has been a rapidly growing segment of the produce industry and now accounts for over 10% of all produce sales in the United States. While fresh-cut vegetables have a significant market share, the fresh-cut fruit category is also contributing to the rapid growth of the fresh-cut industry as processors and fruit marketers are placing increased emphasis on the development of the fresh-cut fruit market. The fresh-cut fruit category is expected to exceed US$1 billion by 2008 (Clement, 2004).

Orange-fleshed cantaloupe (*C. melo* L., Reticulatus Group) and green-fleshed honeydew (*C. melo* L., Inodorus Group) (hereafter referred to as cantaloupe and green honeydew, respectively) melon chunks are common components of fresh-cut fruit products and are available year-round throughout the United States. However, netted melons, such as cantaloupe, have a rough uneven rind that is more difficult to sanitize than the relatively smooth surfaces of honeydews

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(Suslow and Cantwell, 2001; Ukuku et al., 2004), and thus cantaloupe in particular has been associated with numerous outbreaks of foodborne illness in recent years (Center for Disease Control, 1991, 2002; Dewaal et al., 2000). While high temperature treatments of cantaloupes are promising, but not completely effective, precutting sanitation procedures (Suslow and Cantwell, 2001; Ukuku et al., 2004), they can also adversely affect melon taste (Teitel et al., 1989) and have yet to be adapted for large-scale commercial use.

Smooth skinned orange-fleshed honeydews (hereafter referred to as orange honeydew) have become increasingly available in the United States and offer a potentially more microbially safe alternative to fresh-cut cantaloupe as well as offering more variety that consumers desire in fresh-cut fruit products. Since cantaloupes and honeydews are packaged in 40 and 30-lb boxes, respectively, fruit processors are also interested in orange honeydews from a workman's compensation perspective. While honeydews in general have a lower respiratory rate and longer storage life than cantaloupes (Kader, 1992), the keeping quality of various orange honeydew genotypes as a fresh-cut product has not been evaluated or compared to that of cantaloupe or green honeydew.

'Orange Dew' is one of the most extensively grown and commercially available orange honeydews. Other orange honeydew genotypes grown in the United States are 'Temptation', 'Honey Gold' and a number of breeding lines that are being tested by various seed companies. The genetic origin of these orange honeydews can be quite complex and not well defined or it may be proprietary. However, one way to introduce orange hue, i.e., β-carotene production, into green honeydews is to include a backcross with cantaloupe or another orange netted melon at an early stage in the breeding program (Kevin Crosby, personal communication). As such, orange honeydew genotypes may be more genetically diverse and more subject to variations in fruit quality characteristics and storage life than green honeydews.

Besides genetics and breeding programs, melon quality is also affected by cultural practices, weather conditions and maturity at harvest (Beaulieu et al., 2004; Robertson and Decker-Walters, 1999). In the United States, the commercial practice for harvesting cantaloupe is to wait until the melons are 3/4 slip or full slip, i.e., when the abscission zone between the fruit and the stem (peduncle) is 3/4 to fully formed. Cantaloupe harvested at full slip has a shorter shelf-life; and firmness and flavor losses may occur before completion of the marketing process (Hoover, 1955). Honeydews are later maturing than cantaloupe, allowing more time for photosynthates to enter the fruit and thereby increase SSC and fruit sweetness. Minimal commercial maturity is mature, unripe fruit containing an SSC of 10% (stage 1, Kasmire and Cantwell, 1992). Ripening (stage 2) and ripe (stage 3, abscission zone forming) honeydews are also commercially harvested in the United States. Ripe honeydews are considered ideal for eating but have a shorter shelf-life than less mature fruit.

We compared fresh-cut chunks of cantaloupe and honeydews at different maturities for fruit quality characteristics and microbial quality during storage in air at 5 °C for up to 11 days. The overall objective of this study was to determine the feasibility of using orange honeydews for fresh-cut processing.

2. Materials and methods

2.1. Plant material

In 2003 and 2004, cantaloupe (*C. melo* L., Reticulatus Group, 'Cruiser'), green ('Honey Brew') and orange ('Temptation', breeding lines 4470, 4471, and 4524) honeydews (*C. melo* L. Inodorus Group) were grown in commercial melon fields at Rio Grande City, TX. The 2004 planting included two additional orange honeydews, 'Orange Dew' and 'Honey Gold'. In 2003, cantaloupe were harvested at 3/4 slip (usual commercial maturity) and honeydew at or near minimal commercial maturity (stage 1 = mature unripe) when SSC of all genotypes including cantaloupe was similar. In 2004, two harvests were made. In the first harvest, cantaloupe were picked at 3/4 slip and the honeydews at stage 2 (mature ripening) hereafter referred to as commercial maturity. For the second harvest, all genotypes were harvested at or near full slip (mature ripe, honeydew at stage 3) hereafter referred to as full slip. Any fruit that had water-soaked flesh or otherwise appeared overripe were discarded.

After each harvest, fruit were packaged in plastic coolers and shipped overnight to Beltsville, MD, then stored an additional day at 10 °C before fresh-cut processing. Two days after harvest, 12–20 fruit from each genotype were surface sanitized by dipping for 5 min in a 200 μL L^{-1} NaClOH solution adjusted to pH 6.0 using 1 M HCl, blotted with a paper towel and processed at 10 °C using equipment cleaned with 70% (v/v) ethanol. For each genotype, the melons were separated into three or four groups of four fruit (three replicates in 2004 and four replicates in 2003) and each fruit was uniformly peeled on a Muro CP-44 Melon Peeler (Tokyo, Japan). The blossom- and stem-ends were discarded, each fruit was sliced once longitudinally with a sharp knife, seeds and placental tissue were removed and ∼2.5 cm latitudinal slices were prepared using a 0.2 mm-thick stainless steel strap (Ace Co., Boise, ID, USA) held taut in a hacksaw. Preliminary experiments indicated that strap slicing produced a fresh-cut product essentially identical to that from commercial melon-cutting equipment. The strap slicer was also used to prepare 2–3 cm wide chunks in trapezoidal shaped wedges from the melon slices. After chunks from each four-fruit replicate were randomized, samples were removed for respiration and ethylene production rate measurements, microbial analysis and ascorbic acid and β-carotene determinations (see below). Replicate samples for sensory analyses in 2003 were placed in lidded 5.2-L plastic containers, stored for 2 days at 5 °C and vented daily to maintain aerobic conditions. The remaining