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Harvest maturity and postharvest storage condition effects on pomegranate fruit quality

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Abstract. Little is known of the postharvest quality and storage potential of locally grown pomegranate cultivars in Georgia, U.S.A. Seven cultivars were harvested at two maturity stages (early and late) and stored either in regular air (RA; 5 ℃, 90% to 95% R. H.) or in controlled atmosphere (CA; 3% O2, 5% CO2, 5 ℃, 90% to 95% R.H.) for three months. Fruit were evaluated for physical and physiochemical attributes immediately after removal and after 7 days of keeping the fruit at 21℃. Late harvested fruits had significantly increased total soluble solids (TSS) and anthocyanins content compared to early harvested fruit. CA storage significantly reduced fruit disease compared to RA conditions. Acids degradation was significantly reduced in CA as compared to RA. Juice/weight of 50 arils was increased in CA which is an important consideration for fruit destined for juice production.

Keywords. Quality – Harvest maturity – Storage – Controlled atmosphere – Total soluble solids – Anthocyanins – Acid.

I – Introduction

Pomegranate (*Punica granatum* L.), a species of Punicaceae family, is a fruit plant native to the region extending from Iran to the Himalayas. It is believed to be among the first fruits cultivated by humans since about 4000 BC. Within the past few thousand years it has spread all over the world, from Asia to Europe and then to North America. Presently cultivated in the tropical and subtropical regions of the world, it is a plant able to thrive in many different climates and soil conditions and can tolerate drought and salt stress. The production of this fruit has been increasing worldwide in response to increased consumption due to its health benefits (Basu and Penugonda, 2009).

Pomegranate juice has been reported to have antioxidant and antitumor activities (Singh *et al.*, 2002). Various alkaloids, flavonoids, polyphenolic compounds and hydrolyzable tannins, such as punicalin, pedunculagin, punicalagin and ellagic acid esters of glucose are present in the juice of the whole fruit. The juice has shown potential anti-atherogenic properties *in vivo* (Fuhrman *et al.*, 2005). Various organic acids are present in its juice, usually straight chain fatty acids, such as malic acid and citric acid (Neuhofer, 1990; Badria, 2002). Unsaturated fatty acids present in the juice also play an additional role in the antioxidant activity (Melgarejo *et al.*, 1995). The resulting antioxidant activity of the pomegranate juice is due to the contribution of all the potential compounds present in it.

The objectives of this work were:

(i) To study the changes in the physical properties of pomegranate cultivars in different storage conditions.

(ii) To determine the effect of harvest maturity and storage conditions on the physiochemical properties of juice.

II – Materials and methods

Pomegranate fruit were harvested from Ponder Farm in Ty Ty, Georgia, U.S. Seven cultivars (‘Afganski’, ‘Crab’, ‘Cranberry, ‘Entek-habi-saveh’, ‘Kaj-acik-anor’, ‘Nikitski ranni’, ‘Salavatski’) were used for this study. Fruit were harvested at two maturity stages, early and late. At early maturity the fruit is unripe and has not reached the marketable quality. Fruit were brought to the Vidalia Onion Research Laboratory, University of Georgia, Tifton Campus, for analysis. After sorting, fruit were randomly divided into two groups and stored for three months in two storage conditions: regular air storage (RA; 5^{o}C, 90%-95% R.H.) or controlled air storage (CA; 3% $O_{2;}$ 5% CO_2; 90-95% R.H.). After removal from storage, fruit were analyzed immediately and seven days after removal.

Fruit were evaluated for physical quality attributes as weight, color, skin smoothness, disease incidence and physiochemical attributes as total soluble solids, titratable acidity and anthocyanins content. Fruits were weighed and graded for skin smoothness on scale from 1 to 5. Occurrence of sunscald, cracks, bruises and diseases (*Cercospora* and fungal infections) were graded on a scale from 1 to 3. Twenty five arils from two fruit per replication were squeezed in a cheese cloth to collect juice. Titratable acids were measured with an automatic titrator model DL-15 (Mettler Toledo, Switzerland) by using approximately 0.5 g of juice diluted with 25 ml of water. It was titrated to pH 8.2 using 0.1 M NaOH solution. Total soluble sugars were measured with a refractometer (Brixstix digital handheld refractometer, Livermore, CA). A colorimeter (CR-400, Konica Minolta, Ramsey, NJ; 8mm aperture, D65 illuminant) was used to record the fruit skin color, as L*, a*, b*, Chroma, and Hue. L* describes the degree of darkness or lightness with L=0, corresponding to black and L=100 as white; b* refers to the colors in the range yellow to blue; and a* refers to colors ranging from red-purple to blue-green. Color data were transformed using an arc-sine transformation. ANOVA procedure from the SAS Enterprise (SAS Institute, Cary, SC) was used to carry out the statistical analysis.

III – Results and discussion

The harvest time of pomegranate is very important in relation to the physical and physiochemical properties. With advancing maturity, there is increase in content of total anthocyanins, from early 847.40 ppm (s.e. 46.231) to late 1358ppm (s.e.78.3270). TSS and total titrable acids (early 2.7795%; S.E. 0.106 to late 2.92383%; S.E. 0.14479) content also increases with maturity in the juice (Fig. 1). Postharvest storage conditions affect pomegranate fruit quality and thus its marketability (Fig. 2). CA storage significantly reduced the incidence of the fruit disease caused by *Cercospora punica spp.* (CA average 1.50962, S.E. 0.0482 and RA 1.62019; S.E. 0.0439). The major effect of CA storage is on the acid content of fruit. Acids present in the juice degrade to a larger extent in fruit stored in RA (2.24103, S.E. 0.09806) as compared to CA (3.29362, S.E. 0.11343). Acids degradation leads to a change in flavor to a sweetened taste of the fruit. More information is required in order to establish proper harvest maturity.

IV – Conclusions

Controlled atmosphere storage was beneficial in maintaining pomegranate fruit quality in comparison to regular air storage by decreasing both fruit decay and the rate of degradation of juice constituents. Fruit maturity at harvest played an important role in determining fruit quality. Fruit harvested unripe had reduced total soluble solids, reduced acidity and reduced phytonutrient (anthocyanins) concentration.

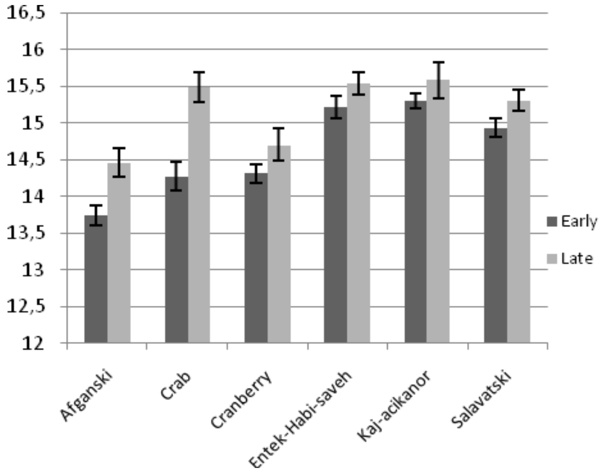

Fig. 1. Total soluble solids (%) in pomegranate fruit of various cultivars at two maturity stages (*P*<0.05).

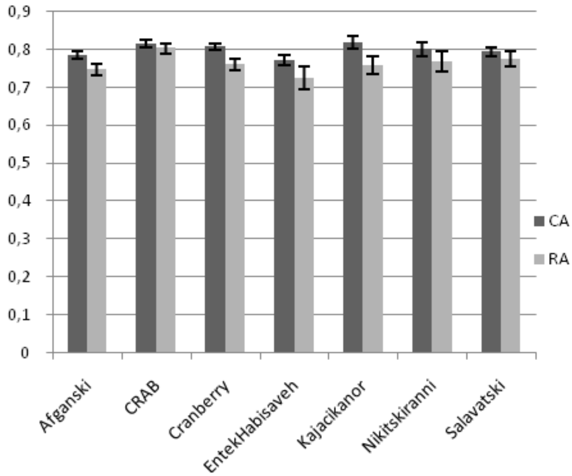

Fig. 2. Effect of storage conditions (CA and RA) on pomegranate juice/weight (g/g) of 50 arils (P<0.05).

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