Assessment of Twenty Two Citrus Cultivars (Oranges, Mandarins and Lemons) for Quality Characteristics and Phytochemical Concentration.

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Abstract

Twoenty two citrus cultivars belonging to three citrus species, namely, orange (Citrus sinensis (L.) Osbeck) (eleven cultivars), mandarin (Citrus reticulata L.) (four cultivars) and lemon (Citrus limon L.) (seven cultivars) were assessed for fruit quality characteristics and juice phytochemicals at maturation. Titratable acidity, pH, total soluble solids, β-carotene, total phenolic compounds, total o-diphenols, total flavonoids, and antioxidant capacity based on DPPH and FRAP assays were assessed. Lemon varieties were characterized by the highest juice yield and its highest titratable acidity. Total soluble solids were high in mandarins, followed by oranges and lastly by lemons. Carotenoids were determined in highest concentration in mandarin varieties while the lowest concentration was found in lemons. Oranges were characterized by high concentration of total phenols, with Salustiana exhibiting the highest value. Valencia clones exhibited the highest concentrations of both o-diphenols and flavonoids. On the other hand, Clementine mandarins and lemons were characterized by high antioxidant capacity, higher than that observed in most of the orange varieties assessed and of Encore and Kara mandarins. The principal component analysis (PCA) revealed an interesting classification of the varieties assessed. Lemon varieties were grouped together; Kara and Encore mandarins belonged to the same group while Clementine mandarins were grouped with orange varieties.

INTRODUCTION

Among fruits, Citrus is the most widely produced fruit, as a group of several species, and it is grown in more than 80 countries (Ladaninya, 2008). Citrus products must be highlighted, as they are a major source of antioxidant compounds intake in the diet of developed countries (Ramflit et al., 2011). The study of the polyphenolic and carotenoid composition of fruits is of great interest owing to the qualitative and quantitative differences appearing as a function of the species, cultivar, degree of ripening, and environmental conditions of growing, ripening, and storage (Obendorf et al., 2011). It is therefore of major importance to be able to assess differences between species and cultivars in terms of fruit/juice quality characteristics and concentration of antioxidant compounds.

The aim of the present trial was to assess a number of citrus speciesbelonging to different three citrus species (namely orange, mandarin and lemon) in terms of juice quality characteristics and try to assemble a pattern describing species and cultivars in a simple way.

MATERIALS AND METHODS

The experiment was conducted at the orchard of Agricultural University of Athens (Latitude 37° 58' N, Longitude 23° 32' E, elevation 30m) during the growing season 2009-2010. Eleven orange cultivars, four mandarin and seven lemon ones were sampled in the present experiment. The orange cultivars were Shamouti, Salustiana, Washington Naval, Navelina, Navelate, New Hall, Moro, Valencia Gamble, Valencia Olimda, Valencia Cutter and Valencia Frost. Mandarin cultivars used were Cara, Encore, Clementine SRA 63 and the Greek one Clementine Porou, while lemon cultivars used were Interdomato, Villa Franca, Santa Teresa, Lisbon and the Greek ones Adamopouilo, Karedreno and Mageleno. Fruits were harvested at full maturity stage and a portion of the hand squeezed juice was immediately put into freezer (for analysis of titratable acidity (TA), total soluble solids (TSS) and pH values); while another part was diluted 1:1 with methanol and then put into freezer till analyses of total phenols, total o-diphenols, total flavonoids (according to Roussos, 2011) and antioxidant capacity, based on DPPH and FRAP assays (Klimczak et al., 2007). For the determination of β-carotene 5 mL of fruit juice solution was extracted with 20 mL of acetone:hexane solution (4.6) and β-carotene concentration was determined spectrophotometrically according to Navarro et al. (2010).

RESULTS AND DISCUSSION

All lemon cultivars assessed in this trial exhibited the lowest pH values followed with significant differences from those of mandarins and oranges (Table 1). TSS values were high in mandarins followed by those in oranges. Lemons exhibited very low TSS values with significant differences from both mandarins and oranges. Similar results have been reported also by Ramflit et al. (2011).

The scatter plot of the PCA revealed interesting relationships (Fig. 1), since lemons were grouped together at the far negative side of component 1 (showing low pH, TSS, and TSS/TA values and high FRAP values). Valencia clones were grouped together at the positive sides of both components (exhibiting high pH, TSS, TSS/TA, total flavonoids, β-carotene values and low TA and FRAP values), the other orange varieties and citruses were mainly grouped at the negative side of component 2 and positive of component 1 (showing high pH, TSS, TSS/TA values and low TA, FRAP, β-carotene and total flavonoid values). The rest of mandarin cultivars were at the positive sides of both components (exhibiting high pH, TSS, TSS/TA, total flavonoids, β-carotene values and low TA, FRAP values), diametrically opposite to that of clementines, which resembled more to orange varieties assessed in this trial.

Table 1. Juice quality characteristics (pH, total soluble solids (TSS, 0Brix), titratable acidity (TA, % citric acid) and carotene (mg/100 ml) of 22 citrus cultivars.

Table 2. Juice total phenols (mg equivalent tannic acid), total o-diphenols (mg equivalent caffeic acid) and total flavonoids (mg equivalent catechin acid) of 22 citrus cultivars.

Literature Cited