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Physico-chemical and antioxidant properties of pomegranate genotypes in Greece

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Abstract. Fruit quality attributes and antioxidants contents were compared among 11 Greek pomegranate genotypes and the foreign cultivars Wonderful, Akko and Hicaznar, established in two collections in the northern Greece. The heaviest fruit were harvested by Wonderful (474 g), 11021 (400 g), Hicaznar (316 g), and T9 and T10 (mean 366 g). Kallisti had the greatest aril weight (0.472 ±0.015 g), whereas Wonderful had the lowest aril weight (0.260 ±0.025 g). The greatest edible portion percentage (62.3%) and juice percentage (44.7%) were found in the genotype 11019. Total soluble solid content ranged between 15.7% (Kallisti) and 18.3% (11019), and total acid content ranged between 4.8 (Hicaznar) and 22.4 g L^{-1} (Wonderful). The genotypes T9 and T10 contained the highest total phenol and ascorbate equivalent antioxidant capacity, which were comparable with Hicaznar and Wonderful. Total anthocyanin contents were lower in the Greek, compared with the foreign cultivars. In conclusion Kallisti is a worthy genotype in respect to having relatively great aril weight, fruit size and being soft seeded, and therefore it should be considered for fresh consumption. The genotype 11019 could be worthy for an industrial point due to its high juice content.

Keywords. Antioxidant capacity – Anthocyanins – Fruit quality – Phenols.

I – Introduction

The pomegranate cultivation has only recently been intensified in Greece; from being a minor fruit crop (51 hectares in 1994 and 200 hectares in 2007, Hellenic Statistical Authority), in the last four years the cultivated areas may have reached up to 1200 hectares (personal communications). A massive introduction of foreign pomegranate cultivars took place (e.g. mainly Wonderful), without prior experimentation on their suitability under the different Greek microclimate conditions. Nevertheless, local pomegranate genotypes with interesting market characteristics are abundant (Drogoudi *et al*., 2005). A comparative study on fruit quality characteristics in local and newly imported cultivars would be useful for the selection of promising new genotypes.

II – Materials and methods

The experiment was performed in fruit collected from the pomegranate Greek genotypes 11029 (Kallisti), 11005, 11019 and 11021 established in a collection orchard at the Pomology Institute in Naoussa, and T1, T2, T4, T5, T7, T9, and T10 genotypes established in a collection orchard at T.E.I.Th. in Sindos Thessaloniki. Fruit from nearby commercial orchard of cultivars Akko, Hicaznar and Wonderful were also used. Twelve fruit from each genotype were transferred in the laboratory, weighed, peeled carefully, and juiced by pressing the arils in a four layer cheesecloth. Fruit fresh weight, aril weight, edible portion and juice percentage were measured. Soluble solid content (SSC) was measured using a digital refractometer (model PR-1, Atago, Japan), and titratable acidity (TA) was measured by titration to pH 8.2 with 0.1 N NaOH and expressed as citric acid content (g l^{-1}). A portion (50 ml) of extracted juice was kept at -20°C until further analysis.

Total phenolic content of the pomegranate juice was assayed according to Folin-Ciocalteu method (Singleton and Rossi, 1965). Gallic acid was used as a standard and the results were expressed as mg gallic acid equivalent 100ml^{-1} juice. Total ascorbate equivalent capacity (AEAC) was determined using the stable 1,1- diphenyl-2-picryl hydrazyl (DPPH) free radical (Blois, 1958), which has an intense violet colour, but turns colourless as unpaired electrons are sequestered by antioxidants. Ascorbic acid used as a standard and the results were expressed as mg ascorbic acid equivalent 100ml^{-1} juice.

The total anthocyanin content was estimated by pH differential method using two buffer systems: potassium chloride buffer, pH 1.0 (25mM) and sodium acetate buffer, pH 4.5 (0.4M) (Cheng and Breen, 1991) and at two wavelengths of 510 nm and 700 nm. The samples were diluted ten times in 80% ethanol (1% HCl). The total anthocyanins content was calculated as follows: total anthocyanins = [(A×MW×DF×100)/MA], where A = (A_{510} −A_{700}) pH1.0 −(A_{510} −A_{700}) pH4.5; MW: molecular weight (449.2); DF: dilution factor; MA: molar absorptive coefficient of cyaniding-3-glucoside (26.900). Results were expressed as mg cyaniding-3-glucoside 100 ml^{-1} of juice.

Data were subject to ANOVA and then significant differences between individual means were determined using the Duncan's multiple range test at the 5% level, using the statistical software SPSS 12.0 (SPSS Inc., Chicago, USA). Correlations analyses were also performed.

III – Results

The heaviest fruit were harvested by Wonderful (474 g), 11021 (400 g), Hicaznar (316 g), and T9 and T10 (mean 366 g), and the lightest by Akko, T5 and T7 (264.0 g) (Table 1). The greatest aril weight (0.472 ±0.015 g) was measured in Kallisti, whereas Wonderful had the lowest aril weight (0.260 ±0.025 g) (data not shown). The greatest edible portion percentage (62.3 %) and juice percentage (44.7 %) were found in 11019 accession (Table 1). The highest and the lowest SSC were recorded in genotype 11019 (18.3%) and cultivar Kallisti (15.7%) respectively, whereas titratable acidity ranged between 4.8 (Hicaz) and 22.4 g l^{-1} (Wonderful).

Table 1 Mean fruit fresh weight (FW, g), % edible portion, % juice, soluble solid content (SSC, %), titrable acidity (TA, g l^{-1}), total phenolics (TPhs, mg gallic acid equivalent 100ml^{-1}), total anthocyanins (TAnth, mg cyaniding-3-glucoside 100 ml^{-1}) and ascorbate equivalent antioxidant capacity (AEAC, mg ascorbic acid 100ml^{-1}) in different pomegranate cultivars and accessions

	FW	% edible	% juice	SSC	TA	TPhs	TAnth	AEAC
Kallisti	332.0 ab	58.7 bc	41.3 ef	15.7 a	6.1 abc	46.8 a	5.2 a	60.2 a
11005	298.1 ab	52.3 abc	32.4 cd	17.1 cd	9.5 de	77.4 c	13.9 a	122.3 def
11019	296.9 ab	62.3 c	44.7 f	18.3 e	7.9 cd	54.0 a	8.2 a	72.4 ab
11021	400.3 cd	45.9 ab	31.3 bc	16.5 abc	10.4 e	62.5 b	4.9 a	89.6 bc
T1	302.2 ab	42.9 a	21.3 a	15.9 ab	5.0 ab	82.1 c	10.2 a	127.8 ef
T2	275.3 ab	47.7 ab	27.1 ab	16.2 abc	7.2 bc	80.3 c	10.3 a	126.1 ef
T4	308.0 ab	48.5 ab	25.3 ab	18.0 de	5.0 ab	81.9 c	9.8 a	123.4 def
T5	257.4 a	50.7 abc	27.9 ab	16.7 abc	4.5 a	80.7 c	11.7 a	118.3 de
T7	252.0 a	46.7 ab	24.4 a	16.4 abc	5.4 ab	80.2 c	9.7 a	119.4 def
T9	366.9 bc	40.4 a	20.6 a	16.5 abc	6.1 abc	84.0 cd	8.0 a	138.6 f
T10	364.5 bc	45.6 ab	25.5 a	16.0 ab	6.0 abc	84.3 cd	9.1 a	139.4 f
Akko	273.6 a	53.6 abc	37.9 de	16.9 bc	6.2 abc	83.3 cd	41.3 b	106.0 cd
Hicaznar	315.8 abc	47.2 ab	31.2 cd	16.5 abc	4.8 a	92.1 d	83.6 d	124.5 ef
Wonderful	474.2 cd	53.0 abc	35.0 cd	17.1 cd	22.4 f	88.3 cd	59.1 c	124.8 def

Means in each column followed by different letters are significantly different at $P < 0.05$.

Cultivar Hicaznar had the greatest total phenol (92.1 mg gallic acid equivalent $100ml^{-1}$) and anthocyanin (91.2 mg $100ml^{-1}$) contents, which were up to 2 and 18.6 times greater, respectively, compared to the rest studied genotypes. Significant differences among the studied pomegranates were also found in the AEAC ranging from 60.15 ±3.5 to 139.4 ±16.6 mg ascorbic acid equivalent $100ml^{-1}$. The greatest and the lowest antioxidant activity were detected in Wonderful and Kallisti cultivars, respectively. AEAC was positively correlated with total phenols (r^2=0.846), but not with total anthocyanin content. Similar values for all measured traits were also previously reported for 11029 (Kallisti), 11005, 11019 and 11021 (Drogoudi et al., 2005).

Important variation was found in all parameters measured, suggesting that genotype is an important factor determining fruit quality attributes in pomegranate. Kallisti is a worthy genotype in respect to having relatively great aril weight, fruit size and being soft seeded, and therefore it should be considered for fresh consumption. The genotype 11019 could be worthy for an industrial point due to its high juice content. Hicaznar, Wonderful and the genotypes T9 and T10 were superior in respect to containing relatively high antioxidant contents.

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