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Characterization of six varieties of Moroccan pomegranate

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Abstract. This study evaluated the characteristics of six pomegranate varieties ("Sefri", "Ounk Hman", "Ruby", "Rouge Marrakech", "Bouaâdime" and "Jaune Marrakech"), being all indigenous to four provinces in Morocco where the species shows high variability. A morphological and organoleptic characterisation of the fruits and of the edible portion of the seeds were investigated. Some chemical characteristics of the juice, including total soluble solids, pH, acidity, crude fiber and maturity index, were assessed. The results of the study reveal that the Moroccan varieties present an average top weight to 430g/fruit and one big caliber. The assessment of pomegranate chemical compositions implies the great potential of Moroccan cultivars for both fresh market and fruit processing.

Keywords. Characterization – Fruit – Seeds.

I – Introduction

Pomegranate (*Punica granatum* L.) is an important tree of the tropical and subtropical regions of the word which is valued for its delicious edible fruit. It is cultivated in Iran, Afghanistan, India, Mediterranean countries, (Morocco, Spain, Turkey, Tunisia and Egypt) and Middles-East countries are the main regions of pomegranate cultivation and production (Jbir *et al.*, 2008; Melgarejo *et al.*, 2009). In Morocco the total production exceeded 58000 tn in 2005 and one surface of the 4625 ha (MAPM, 2005). Beni Mellal is the first region in Morocco in production and surface (1410 ha and 28800 tn) (ORMVAT, 2002). In recent years, there has been an explosion of interest in pomegranate fruit, because it is considered to be a functional product of great benefit in the human diet as it contains several groups of substances that are useful in disease risk reduction (Martínez *et al.*, 2006; Çam *et al.*, 2009a). In spite of various pomegranate cultivars grown in different regions of the Morocco, few published results on the properties on the cultivars in the literature are available, therefore, the aim of this work was to determine the physico-chemical characteristics, as well as the total soluble solids and titratable acidity, two parameters whose ratio defines the taste of pomegranate juice the six varieties grown in Morocco in order to gain more knowledge about the juicy potential of the fruits.

II – Material and methods

1. Plant material

Six varieties of pomegranate: "Sefri", "Ounk Hman", "Ruby", "Rouge Marrakech", "Bouaâdime" and "Jaune Marrakech", were collected from four provinces in Morocco. Fifteen kg of each variety were picked at commercial ripening. Once in the laboratory the pomegranate with defects (sunburns, cracks, cuts and bruises in peel) were discarded.

2. Characterization of the fruit and the seeds

From each cultivar and replication, 20 pomegranates were randomly picked every single year. The following fruit characteristics physical were studied: fruit weight, equatorial diameter, calyx diameter, fruit height without calyx, total fruit height, calyx height, number of carpels, skin thickness. Later the juice was extracted using an electric extractor and a seed sample of 100 g. Total soluble solids (TSS) was determined in triplicate from the juice obtained for each sub-sample with a digital refractometer Atago N1 (Atago Co. Ltd., Tokyo, Japan) at 20ºC, and expressed as % (ºBrix). Total acidity (TA) was also determined in triplicate in each sub-sample by automatic titration (877 Titrino plus, Metrohm) with 0.1 N NaOH up to pH 8.1, using 1 ml of diluted juice in 25 ml distilled H_2O, and results expressed as g citric acid per L^{-1}. Maturity index (TSS/TA). Up to date the following classification has been established for Spanish varieties (Melgarejo, 1993): Sweet varieties: MI=31-98; Sour-sweet varieties: MI=17-24 and Sour varieties: MI=5-7. Moisture percentage of pulp was determined by dried in a hot air oven at 50ºC until constant weight. Four repetitions per variety were carried out. Crude fiber (CF) contents were determined by a digestor Ankon220 fiber analizer model A220 made in USA, following the official methodology established by the Spanish Ministry of Agriculture, Fisheries and Food (MAPA, 1993).

III – Results and discussions

The average weight of the fruits of the Moroccan studied varieties changes inside a range understood between the 430.81 g “Rouge Marrakech” and the 535.06 g “Sefri” (Table 1), qualifying of big size, according to the criteria used for the Spanish varieties by Melgarejo (1993). The higher calibre of fruit was shown of the variety "Sefri", not presenting statistically significant differences with “Ounk Hman”, “Ruby” and “Jaune Marrakech”, whereas the lower calibre was shown by “Rouge Marrakech” (Table 1).

Table 1. Mean values of principal morphological parameters of the fruits

Cultivar	Pf (g)	D1 (mm)	D2 (mm)	L1 (mm)	L2 (mm)	L3 (mm)	Nc	Pc+Mc (g)	Ec (mm)	Rs (%)
'Sefri'	535.0b	100.44b	20.48a	87.80cd	99.65ab	11.85a	7.06c	207.76a	3.5a	60.98c
'Ounk Hman'	481.28ab	96.58ab	23.30b	84.14abc	97.92ab	13.78a	6.45b	205.85a	4.27ab	57.49bc
'Ruby'	504.36b	96.85ab	21.12ab	89.15d	103.65b	14. 51a	6.28ab	223.56a	4.25ab	55.96ab
'Rouge Marrakech'	430.81a	93.92a	22.02ab	82.10ab	94.33a	12.23a	5.9a	197.01a	4.93b	54.79ab
'Bouaâdime'	435.45a	92.85a	20.90ab	80.75a	95.18a	14.42a	6.45b	202.89a	3.66a	53.20a
'Jaune Marrakech'	484.15ab	96.48ab	21.67ab	85.07bc	97.13a	12.27a	6.60b	213. 84a	4.78b	55.74ab

The values followed by the same letter show no statistically significant differences ($P < 0.05$).
Pf: fruit weight; D1: equatorial diameter; D2: calyx diameter; L1: Fruit height without calyx; L2: Total fruit height; L3: Calyx height; Nc: Number of carpels; Ec: Skin thickness; Rs: Seeds yield; Pc+Mc: Skin weight + membranes

Table 2 showed pomegranate qualitative traits. TSS contents significantly differed among the evaluated varieties, ranging from 15.2º Brix to 17.6º Brix for “Sefri” and “Bouaâdime”, respectively. This TSS interval range agreed with those reported from other collections grown in different regions around the world (Chace *et al.*, 1981; Khodade *et al.*, 1990; Barone *et al.*, 1998, 2001; Fadavi *et al.*, 2005; Martínez *et al.*, 2006; Calín-Sánchez *et al.*, 2010; Dafny-Yalin *et al.*, 2010; Tehranifar *et al.*, 2010; Cristofori *et al.*, 2011). TSS assessment is not only important for juice quality evaluation, but for determining also the suitability of cultivars for pomegranate winemaking (Seser *et al.*, 2007). Regarding total acidity contents (TA), remarkable differences were found among Moroccan cultivars. “Bouaâdime” scored the highest content by far (4.7 g l^{-1} of citric acid), whereas all the

others just ranged from 2.1 to 3.3 g l^{-1}. Moroccan TA contents were similar to those showed by Spanish, Italian and Iranian cultivars (Martínez *et al.*, 2006; Tehranifar *et al.*, 2010; Cristofori *et al.*, 2011). The acidity content definitively plays an important role in the perception of fruit quality. Data from other collections around the world suggested that the TA content and pomegranate taste depend on climate and growing conditions (Dafny-Yalin *et al.*, 2010). The taste and flavor of pomegranates clearly rely on the maturity index (MI) (Martínez *et al.*, 2006; Çam *et al.*, 2009b). The MI significantly varied among Moroccan cultivars (Table 2). Whereas "Sefri" showed a MI of 73.25, "Bouaâdime" MI was 37.42. According to Martínez *et al.* (2006), Moroccan pomegranate varieties were grouped as sweet. Likewise, previous studies reported variable ranges of maturity indexes (Martínez *et al.*, 2006; Çam *et al.*, 2009b; Sarkhosh *et al.*, 2009). So it can be stated that pomegranate juice maturity index was basically conditioned by the cultivar factor. Since the evaluated Moroccan varieties showed high TSS contents, they are suitable for both fresh market and juice processing.

Table 2. Chemical properties of pomegranate juices from evaluated Moroccan cultivars

Cultivar	pH	TSS (ºBrix)	Acidity (g/l)	Moisture (%)	Maturity index	Crude fiber (%)
"Sefri"	5.15 a	15.28 a	2.14 a	81.45 c	73.25 cd	0.910 a
"Ounk Hman"	4.73 a	16.10 bc	2.21 a	80.90 c	77.64 d	0.999 ab
"Ruby"	5.46 a	16.55 c	3.01 bc	79.17 b	59.67 bc	1.786 c
"Rouge Marrakech"	4.98 a	15.95 b	2.53 ab	82.25 c	66.14 cd	0.964 ab
"Bouaâdime"	4.05 a	17.60 d	4,71 d	77.04 a	37.42 a	2.133 d
"Jaune Marrakech"	4.49 a	15.67 ab	3.33 c	80.82 bc	48.17 ab	1.051 b

The values followed by the same letter show no statistically significant differences ($P < 0.05$).

IV – Conclusions

Statistically significant differences were observed among the evaluated Moroccan pomegranates. The assessment of pomegranate chemical compositions implies the great potential of Moroccan cultivars for both fresh market and fruit processing.

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