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EVALUATION OF POMOLOGICAL PROPERTIES OF SOME ORANGE VARIETIES FROM WEST MEDITERRANEAN TURKEY

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Abstract

Citrus trees can be productively grown in Mediterranean region of Turkey. In this study, six orange varieties (Belladonna, Biondo, Biondo Riccio, Calabrese, Mediterranean Sweet, Parson Brown), grafted C. aurantium L. var. 'Yerli', were re-evaluated under Antalya ecological conditions. During the 2 consecutive trial years, fruit dimensions (weight, height, width), rind thickness, seed number, total soluble solids (TSS), titratable acidity (TA), TSS/TA ratio, fruit juice content, pH, vitamin C content were analyzed. There were statistically differences according to some pomological properties of six varieties. Mediterranean Sweet has the biggest fruits (187.54 g). The highest TSS ratio (11.0%) and vitamin C content (61.20 mg/100ml) was in Parson Brown orange. Biondo fruits have the lowest rind thickness.

Key words*: Citrus, C. sinensis, fruit quality.*

INTRODUCTION

Mediterranean basin has suitable ecological conditions to enable the edible production of citrus fruits. Citrus species are the most important fruit groups for Turkey in view of production and export quantities. Orange (*Citrus sinensis*) is the first species among *Citrus* with high level of production. Tropical and semitropical citrus fruits are more concentrated in subtropical regions (Davies and Albrigo, 2005). Located in the Mediterranean basin, Turkey has quite favorable ecological conditions for production of quality edible citrus (Tuzcu, 1998). China, Brazil and India are the top countries in world citrus production (FAO, 2017). Turkey is the 9th country with 4,293,007 tons among the major citrus producers in 2016 (TUIK, 2017). The citrus fruits are generally the first in the total export of fresh fruits and vegetables in Turkey (AKİB, 2017).

Although Turkey is no homeland of citrus, a lot of varieties have been brought from different countries has led to the emergence of an important gene source. The ecological conditions of the Mediterranean and Aegean regions in Turkey allow for citrus cultivation successfully. In his way, Turkey has been the potential to competing with other Mediterranean countries in terms of quality (Tuzcu, 1998). It is important to evaluate well-adapted, productive and having good fruit quality varieties for optimal growing (Yılmaz et al., 2013).

The fruit quality of the citrus species is affected by cultivars or types, rootstocks, ecology and cultural practices (Ozcan and Ulubelde, 1984; Economides and Gregoriou, 1993; Castle 1995; Tuzcu et al., 1999). Similarly Hodgson (1967) emphasized that fruit quality is influenced by three main factors as climate, rootstock and nutrition. Moreover, climate is the most important parameter affecting fruit quality and size.

In this study, the pomological characteristics of some sweet orange varieties have been evaluated in the Antalya region, which has an important potential for citrus growing.

MATERIALS AND METHODS

The present research was conducted on citrus germplasm collection of Bati Akdeniz Agricultural Research Institute (BATEM) in Antalya (Turkey) during 2015 and 2016. Six orange varieties (Belladonna, Biondo, Biondo Riccio, Calabrese, Mediterranean Sweet and Parson Brown), budded on the sour orange 'Yerli' (*Citrus aurantium* L. var. 'Yerli') in

1938, were used as plant material. The experimental plot located at 36° 52' 29.9'' N and 30° 43' 28.5'' E latitude, the altitude is about 37 m. Sweet orange orchard had a typical Mediterranean climate, and soil had alkaline reaction, calcareous, unsalted, and rich in phosphorus.

The fruits were randomly harvested from all sides of different 4 trees for each variety in middle-January on both trial years. 20 healthy fruits were used for pomological analyzes. The fruit quality parameters of orange varieties were assessed according to (Ozsan and Bahçecioglu, 1970).

Different physical and chemical parameters i.e. fruit weight, fruit height, fruit diameter, rind thickness, segment number, seed number, juice content, total soluble solids (TSS), total acidity (TA) and ascorbic acid were evaluated. Fruit dimensions and peel thickness were measured with a digital caliper (0.01 mm sensitivity). The fruits, which had almost same color and dimensions, were weighed by 0.01 g sensitivity balance (Shimadzu) and their juice extracted. The juice retrieved was weighed and calculated the fruit content percentage. Segment number and seed number were counted. Total soluble solid (TSS in ^{o}Brix) was measured using hand refractometer (N.O.W Tokyo 0~32). Titratable acidity (TS) was determined with AOAC method (NaOH 0.1 N to pH 8.1) using a titrator and expressed as grams of anhydrous citric acid/100 ml fruit juice. Maturity index (TSS/TA) was calculated. pH of fruit juice was measured by digital pH meter (WTW Ino Lab). The ascorbic acid content was determined as reported earlier by using method of Horwitz (1975) and expressed mg/100 ml.)

The experimental design was performed according to a randomized design with 4 replications, each replication consisting of one tree. Data analysis was done by analysis of SAS statistical software and means were separated by using LSD test at ($P \leq 0.05$). Average data of last 2 years were presented in this present study.

RESULTS AND DISCUSSIONS

It has been observed that the sweet orange varieties, budded on *C. aurantium* L., are able to maintain their commercial significance in terms of both yield and quality even in advanced ages under appropriate cultural conditions (data were not shown here).

Results of average of some pomological characteristics of six orange varieties for last two consecutive years are shown in Table 1 and Table 2.

Fruit quality is an occurrence that expresses many different parametrizes. Each fruit has specific fruit quality factors although there are similarities among others. Janick and Moore (1975) set these factors as: fresh size, shape, colour, peel, juice soluble solid, solid: acid ratio, flavor, ease of peeling, seed content and juice content.

It is well known fruit size is very important especially consuming as fresh fruit. The variance analysis showed that fruit weight of orange varieties was significant ($P \leq 0.05$). The highest fruit weight was the obtained from Mediterranean Sweet (187.54 g) while the lowest one was Biondo Riccio (151.71 g). Tuzcu (1990) reported these values of different orange varieties grown in Turkey as; 191.16 g (Yafa), 160.81 g (Valencia), 160.99 g (Hamlin), 198.91 g (Finike Yerli), 162.36 g (Alanya Dilimli), 165.97 g (Kozan Yerli), 164.06 g (Dörtyol Yerli). The weight of different Valencia clones in Antalya changed between to 228.71 g (VAA 75) and 214.82 g (VAA 59) (Tuncay, 2005). Fruit weight was determined by Altan (1995) as 205 g (Hamlin), 164 g (Magnum Bonum), 148 g (Dörtyol Yerli), 196 g (Kozan Yerli) and 157 g (Valencia) in Çukurova Region. Khan (2015) stated that fruit weight was between 189.75 g (Pineapple) to 140.50 g (Robel) in Pakistan. Even if fruit weights of our results are different, they are included in the boundary of others. The current differences can be attributed to differences of tree age and ecology.

The highest average fruit height for last two years was taken from Calabrese (70.99 mm) and Mediterranean Sweet (70.02 mm). Statistically significant differences were obtained between orange varieties expressed in Table 1. Similarly, fruit diameter of trial oranges has significant difference ($P \leq 0.05$) according to variance analysis.

As seen in Table 1, Mediterranean Sweet had the widest fruits diameter with 71.81 mm, while Biondo Riccio had the small one with

67.09 mm. Tuncay (2005) stated that the fruit length/width of Valencia and Yafa clones grown in Antalya were the 77.14 mm (VAA 72)/ 76.13 (VAA 70) mm and 91.21 mm/ (YAA 46) 80.92 mm (YAA 45).

When compared to the rind thickness of the fruits there was no significant differences, even though the thin-rind fruit obtained from cv. Biondo (3.66 mm), Mediterranean Sweet (4.07 mm) had the thicker-rind. All these reports indicated that fruit dimensions and rind thickness can vary to ecology.

Tuzcu et al. (1999) have stated that segment number is an important genetic factor and also it does not affected to rootstocks, climatic conditions and etc. This notification is confirm to our results, which there was no significant difference of segment number among trial varieties (Table 1).

Fruit quality and its appearance are very important from a consumer's viewpoint. Especially seedless fruit are desired quality characteristics for orange citrus. In this study, Calabrese, Biondo, Biondo Riccio and Mediterranean Sweet oranges were defined as commercial seedless varieties in Antalya (south Turkey).

Table 1. Main fruit characteristics of orange varieties (mean of two years)

Variety	Fruit weight (g)	Fruit height (mm)	Fruit width (mm)	Rind thickness (mm)	Segment number	Seed number
Belladonna	175.18±21.77 ab	66.38±1.50b	70.99±1.97a	3.80±0.32	9.37±0.44 c	6.84±1.56 cd
Biondo	162.36±15.55 bc	65.67±1.10 bc	67.68±2.84b	3.66±0.35	9.45±0.24 c	4.55±1.56 ab
Biondo Riccio	151.71±30.64 c	63.54±4.81 c	67.09±4.14b	3.92±0.13	9.36±0.36 c	5.55±1.06 bc
Calabrese	173.43±14.89 ac	70.99±1.64a	69.53±2.62ab	3.97±0.22	9.87±0.27 b	3.07±0.96 a
Mediterranean Sweet	187.54±10.32 a	70.02±2.50 a	71.81±1.37a	4.07±0.17	10.33±0.33 a	5.16±0.84 bc
Parson Brown	160.24±15.38 bc	63.07±1.03 c	68.99±2.23 ab	3.97±0.24	9.91±0.36 b	8.09±3.17 d
LSD (0.05)	22.006	2.8231	3.0545	NS	0.3876	1.964

*Mean separation within columns by LSD multiple range test P≤0.05.

Fruit quality, is eventually a matter of consumer preference, can measure as physical traits and chemical composition. In current study, some chemical properties are evaluated and shown in Table 2. Juice content changed between 59.78% (Calabrese) 56.91% (Mediterranean Sweet). There was no significant difference among orange cultivars. Juice content was expressed as different ratio in a lot of research established different ecology (Tuzcu, 1990; Tuzcu et al., 1993; Yılmaz et al., 2013). Total soluble solid (TSS), juice acidity (TA) and TTS/TA are abundant quality parameters in citrus.

Table 2. Main fruit quality properties of orange varieties (mean of two years)

Variety	Fruit juice content (%)	Total Soluble solids (%)	Acidity (%)	Soluble solids/ Acidity	pH	Ascorbic acid mg/100ml
Belladonna	56.94±2.09	8.33±0.57 bc	1.44±0.12	5.90±0.95	3.38±0.43	54.86±2.04bc
Biondo	59.70±2.37	9.30±0.95 b	1.70±0.31	5.81±1.65	3.31±0.37	49.60±1.76de
Biondo Riccio	57.22±3.04	8.85±1.20 bc	1.71±0.41	5.72±2.05	3.27±0.33	57.10±2.58b
Calabrese	59.78±3.62	7.48±1.44 c	1.51±0.11	5.04±1.25	3.07±0.21	46.71±1.40e
Mediterranean Sweet	56.91±2.33	8.83±1.82 bc	1.49±0.23	6.68±2.51	3.08±0.13	52.44±6.21cd
Parson Brown	56.82±1.15	11.00±1.94a	1.58±0.20	7.26±2.11	3.32±0.51	61.20±2.86a
LSD (0.05)	NS	1.6049	NS	NS	NS	3.6987

*Mean separation within columns by LSD multiple range test P≤0.05.

Parson Brown had the highest with 11% TTS but Calabrese had the lowest (7.48%), and difference among orange varieties was significant (P≤0.05). Our TTS results are almost similar to reports of Khan (2015) and Tuzcu (1990). TA, TTS/TA and pH values of trial varieties were no significant. Fruit quality is foremost an inherent scion cultivar trait. It can be modified but not radically changed without genetic manipulation (Castle, 1995). Among the secondary factors, climate is widely recognised as a major fruit quality factor

judging by the prominence of climatic adaptation on plant breeders' lists of objectives (Hodgson, 1967; Janick and Moore 1975). In citrus, rootstocks have many scion interactive effects; the principal internal factors are juice content and colour, and soluble solids, acid concentrations and their ratio (Wutscher, 1988).

Citrus fruits have been consumed for good sources of antioxidant. Stuetz et al. (2010) stated that they were acknowledged as a good source of ascorbic acid and carotenoids. There were statistically significant differences among cultivars in terms of ascorbic acid ($P \leq 0.05$) (Table 2). Parson Brown had the highest ascorbic acid (61.20 mg/100 ml) content. The lowest was determined in the Calabrese variety (46.71 mg/100 ml). Ascorbic acid value of orange was found between 36.90 mg/100 ml (cv. 'Lsen Asfour', in Tunus) by Tounsi et al., (2011) and 61.7 mg/100 ml (cv. 'Hamlin', in Çukurova) by Altan (1995). Gülbahar et al. (2009). Research as indicated that ascorbic acid contents of fruits are affected by genetic, climatic factors, soil structure repining level and also quantity and quality of sunlight. This statement confirms the differences in the results of obtained from different researches on ascorbic acid content. On the other hand, among the secondary factors, climate is widely recognised as a major fruit quality factor judging by the prominence of climatic adaptation on lists plant breeders (Hodgson, 1967).

CONCLUSIONS

The present study demonstrated differences in fruit quality parameters in some orange varieties grown in Antalya (south-west Turkey) conditions. Mediterranean Sweet orange variety had high performance of almost all quality parameters, especially fruit weight. The Calabrese, Biondo, Biondo Riccio and Mediterranean Sweet varieties were as relatively commercial seedless. These results considered to be a valuable reference for forthcoming studies on pomological and biochemical characteristics of oranges to decide the most favorable one for commercial production. In addition, it has been observed that the sweet orange varieties, budded on *C. aurantium* L, are able to maintain their commercial significance in terms of both yield and quality even in advanced ages under appropriate cultural conditions.

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REFERENCES

AKİB, 2017. Mediterranean Exporter Associations Evaluation Report in December in 2015-2016 Turkey January to. Fresh fruit and vegetable exporter associations http://www.akib.org.tr/files/downloads/arastirmaraporlari/ysm/yms-degerlendirme raporu%20ocak-subat-2016.pdf. Accessed: 12.05.2017.

Altan A., 1995. Çukurova bölgesinde yetiştirilen beş portakal çeşidinin meyve suyu teknolojisi bakımından önemli bazı özellikleri, Gıda, 20 (4): 215-225

AOAC, 1995. Official methods of analysis. 16th edn. Association of Official Analytical Chemists, Washington, DC.

Castle W.S., 1995. Rootstock as a fruit quality factor in citrus and deciduous tree crops. New Zealand Journal of Crop and Horticultural Science 23: (4) 383-394.

Davies F.S., Albrigo L.G., 2005. Citrus. (translated: Dalkılıç Z.) Adnan Menderes University, Aydın, (22): 272.

Economides C.V., Gregoriou C., 1993. Growth, yield and fruit quality of nucellar frost 'Marsh' grapefruit on fifteen rootstocks in Cyprus. Journal of the American Society for Horticultural Science, 118 (3): 326-329.

FAO., 2017. Statistical database. http://www.fao.org/faostat/en/#data/QC. Accessed: 12 May 2017.

Gülbahar C., Döngel M., Aslan D., 2009. Bazı sebzelerin çiğ ve pişmiş durumlarındaki C vitamini tayini. MEB-TÜBİTAK Türkiye Sanayi Sevk ve Idare Enstitüsü, Gebze, 1-14.

Hodgson R.W., 1967. Horticultural varieties of citrus. Reuther W., Webber H.J., Batchelor L.D. ed. Berkeley, University California Press. in: The citrus industry, Vol. 1., 431-591.

Horwitz W., 1975. Official methods of analysis of the association of official chemists (AOAC). 12 ed., Washington D.C., 1094.

Janick J., Moore J.N. (ed.) 1975. Advances in fruit breeding. West Lafayette, IN, Purdue University Press, 623.

Khan K., Rehman A., Zeb T., Jadoon M., Ullah I., Shamrez B., 2015. Performance evaluation of various sweet orange varieties under the agro-climatic conditions of haripur hazara. Asian Journal of Agricultural Sciences, 7 (1): 1-3.

Ozcan M., Ulubelde M., 1984. Turunçgil anaçları. Tarım Orman ve Köyişleri Bakanlığı Proje ve Uygulama Genel Müdürlüğü. Ege Bölgesi Zirai Araştırma Enstitüsü Yayınları. No: 50. İzmir. 37 s.

Ozsan M., Bahçecioglu H.R., 1970. Akdeniz bölgesinde yetiştirilen turunçgil tür ve çeşitlerinin değişik ekolojik şartlar altında gösterdikleri özellikler üzerinde araştırmalar. TÜBİTAK-TOAG Yayın No: 10. TÜBİTAK Matbaası. Ankara. 111 s.

Stuetz W., Prapamontol T., Hongsıbsong S. and Bıesalskı H.K., 2010. Polymethoxylated flavones, flavanone glycosides, carotenoids, and antioxidants in different cultivation types of tangerines (*Citrus reticulata* Blanco cv. 'Sainampueng') from Northern Thailand J. Agric. Food Chem, 58: 6069-6074 6

Tounsi MS., Wannes W.A., Ouerghemmi I., Jegham S., Njima Y.B., Hamdaoui G., Zemni H., Marzouka B., 2011. Juice components and antioxidant capacity of four Tunisian citrus varieties. J. Sci. Food Agric, 91: 142-151.

TUİK., 2017. Statistical database. https://biruni.tuik.gov.tr/bitkiselapp/bitkisel.zul. Accessed:12 May 2017.

Tuncay M., Demirel H., Apaydın H.Y., 2005. Turunçgillerde aşıgözü seleksiyon- sertifikasyonu ve çeşit geliştirme projesi ii. turunçgil çeşitlerinin seleksiyonu. Proje Sonuç Raporu (Yayınlanmamış).

Tuzcu O., 1990. Türkiye'de yetiştirilen başlıca turunçgil çeşitleri. Akdeniz İhracatçı Birlikleri Yayınları. Nurol Matbaası, Ankara, 71

Tuzcu O., 1998. Turunçgiller lisans ders notları. Ç.Ü. Ziraat Fakültesi Bahçe Bitkileri Bölümü. Adana. (Yayınlanmamış).

Tuzcu O., Kaplankıran M., Düzenoglu S., 1993. Değişik turunçgil anaçlarının Washington navel, Valensiya, Moro ve Yafa portakal çeşitlerinin meyve verim ve kalitesi üzerinde etkileri. Doğa Türk Tarım ve Ormancılık Dergisi, 17: 575-592.

Tuzcu O., Yıldırım B., Düzenoglu S., Bahçeci İ., 1999. Değişik turunçgil anaçlarının Washington Navel ve Moro kan portakal çeşitlerinin meyve verim ve kalitesi üzerine etkileri. Turkish Journal of Agriculture and Forestry, 23: 213-222.

Wutscher H.K., Bistline F.W., 1988. Rootstock influences juice color of 'Hamlin' orange. Hort Science 23 (4): 724-725.

Yılmaz B., İncesu M., Çimen B., Yeşiloglu T., Pamuk S., 2013. Bazı göbekli portakal çeşitleri ile türkiye'de selekte edilmiş bazı Washington Navel tiplerinin adana ekolojik koşullarında verim ve kalite özelliklerinin belirlenmesi. TABAD, 6 (2): 05-11.


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