The Libyan Journal of Agriculture
Volume (23), No. (1-2): 2018: 54- 62

Original Article

Evaluation of fruit quality characteristics of Libyan and imported navel oranges.

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Abstract

The aim of this study was to investigate the quality of local Libyan navel orange fruits (LNOF) and imported Egyptian (ENOF) and Tunisian navel orange fruit (TNOF) marketed in Libyan markets. This study also investigated the potential advantages that may grant Libyan navel orange any marketing or competition in local and international markets. This study was carried out in the postharvest laboratory of the western region branch of Libyan agricultural research center in Tripoli. Navel orange fruits of the three geographical sources were sampled weekly from mid-January 2014 to the end of March 2014 according to its availability. The experiment was a complete randomized design with four replicates, each included four sound fruit. The studied characters were fruit weight, longitudinal and equatorial diameter, extractable juice, total soluble solids (TSS), total acidity (TA) and fruit granulation. Results indicated that the ENOF was significantly higher for fruit weight, longitudinal and equatorial diameters, and their ratio compared with LNOF and TNOF. Variables for LNOF were not significantly different from those of TNOF with the exception of the longitudinal-equatorial diameter ratio. The TNOF had significantly the highest extractable juice percentage followed by the LNOF and then the ENOF. The TNOF was significantly higher for TA compared with the LNOF and the ENOF. The LNOF showed significantly higher TSS compared with those from the other two sources. The TNOF had significantly higher amount of TSS than the ENOF. The three geographical sources of navel orange showed significant differences for the TSS/TA ratio, where the LNOF was the highest in TSS/TA followed by the ENOF and the TNOF. ENOF exhibited granulation in the samples studied, while LNOF and TNOF were free from any granulation. The results of this study showed presence of preferential differences between the LNOF and both TNOF and ENOF, where the LNOF was characterized by high value of TSS and TSS/TA ratio that gave LNOF an advantage in local and international markets.

Key words: navel orange, total soluble solid, extractable juice, acids.

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Received: 04/4/2018 Accepted: 01 / 10/ 2018

Introduction

Libyan markets of agricultural products annually receive increasing amounts of navel orange *Citrus sinensis* (L.) Osbeck imported from Egypt and Tunisia. Most of the Libyan navel orange production comes from the western regions of the coastal strip, while most of the Tunisian navel orange trees are grown in Cap Bon region (Laajimi and Mimoun, 2007; Najar *et al.*, 2005). The Delta governorates of Qalyoubia, Beheira, Sharqiya, Ismailia and Menufia are the main producing areas in Egypt (Hamza and Maldonado, 2011; Sherif *et al.*, 2007). The fresh Egyptian orange is suffering from limited export to European Union countries because it does not satisfy the quality criteria of those countries (Hamza and Maldonado, 2011).

Juice content, total soluble solids (TSS), titratable acid (TA), TSS/TA ratio, fruit size and peel color are the most important quality criteria for the fresh fruit market (Agricultural Standards Unit, 2011; Kahn *et al.*, 2007; Kallsen *et al.*, 2011; Lacey *et al.*, 2009; OECD, 2010; Zekri *et al.*, 2012). In California, the ratio of TSS to TA should not be less than 8:1, and is considered a legal criterion for navel orange fruit maturity (Kahn *et al.*, 2007).Fruit size comes in second order in the classification of fruits in the international markets and is expressed by equatorial diameter (Agricultural Standards Unit, 2011). Optimum fruit size is a critical management issue for citrus growers because it is the most important factor determining market returns. Most international markets have a preference for large fruit (>72mm), whereas smaller fruit (<65mm) are often hard to sell (Bevington *et al.*, 2003).

Granulation, also called crystallization or section drying, is a physiological disorder in citrus that results in reduced juice content and sometimes in vesicle shriveling. The parenchyma cells within granulated vesicles have thickened walls. Such changes involve increased concentration of various cell wall components (cellulose, hemicelluloses, pectin and lignin). Granulated vesicles have elevated respiration, increased juice pH, and reduced TSS and acids (Kahn *et al.*, 2007; Ritenour *et al.*, 2004).

Numerous factors affect navel orange fruit quality criteria (Kahn *et al.*, 2007). Some of the most important factors are classified into environmental and agricultural components (Abd El-Migeed *et al*, 2007; Zekri et al., 2012). They include root stock type (Al-Jaleel and Zekri, 2003; Hifny *et al.*, 2012; Hutchison *et al.*, 1992; Shafieizargar *et al.*, 2012), preharvest fruit treatment with GA (Lindhout *et al.*, 2008), fruit storage period, postharvest treatments (Abdel Wahab and Rashid, 2012; Birla *et al.*, 2005; Obenland *et al.*, 2003), geographical location (Kahn *et al.*, 2007), and harvesting date (Iqbal *et al.*, 2012). Many Libyan consumers claim that fresh Libyan navel orange fruits are juicer and have better taste than the imported ones. Egyptian fruits are insipid and dry, while Tunisian navel oranges have an acidic taste.

The objectives of the study were:

1. Explore fruit quality of Libyan navel orange and compare it with those fruits imported from Egypt and Tunisia.
2. Uncover potential preferential advantages of Libyan navel oranges that may grant them competitive advantage in local and international markets.
3. Verify the claim of navel orange consumers regarding juiciness and Taste?

Materials and Methods

The study was conducted at the postharvest laboratory of the western region branch of the Libyan National Agricultural Research Center in Tripoli. All the Tunisian and Egyptian samples and most of Libyan naval orange fruit have been obtained weekly through random purchase from the gross fruit and vegetables central market at Kaser Ben Geashir region, the main supplier of vegetables and fruits for the western region of Libya. Two samples of Libyan naval orange have been obtained directly from two farms located at Tripoli region. The Egyptian navel orange fruits were transported to the Libyan market by refrigerated trucks taking less than two weeks from harvesting to the Libyan market, while the Tunisian navel orange fruits were transported by unrefrigerated trucks taking two days' form harvesting to Libyan markets. The Libyan navel orange fruits were delivered one day after harvesting. First samples for analysis have been obtained on 14-1-2014. The remaining samples were received weekly depending on their availability at the market till 24-03-2014. This study included 7 Libyan, 8 Tunisian, and 9 Egyptian navel orange samples.

Preparation of samples:

Sixteen fully mature colored fruits, free from any defects or decay, were taken and separated randomly into 4 replicates with 4 fruits each, then washed by running water and dried with tissue.

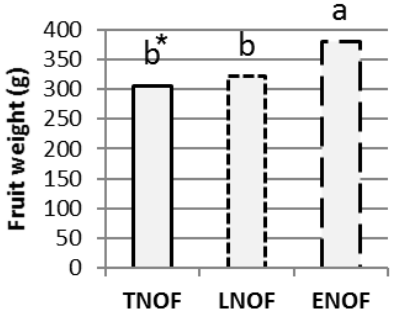
Measurements and analysis:

Each fruit in each replicate was weighed. Its longitudinal and equatorial diameters were measured by vernier calipers. Extractable juice has been extracted using a regular orange juicer and the juice/fruit weight percentage for each replicate was calculated. Total soluble solid (TSS) was measured by Atago PR-100 digital refractometer. Titratable acidity (TA)was obtained by neutralizing 10 ml of juice with 0.1 N NaOH solution and expressed in terms of equivalent anhydrous citric acid per 100 ml of juice. The cut surface of each fruit was visually evaluated for fruit granulation.

The experiment was a complete randomized design (CRD). The data were statistically computed using analysis of variance (ANOVA) and Tukey's multiple range test was used for mean comparison when the F-test was significant at $P < 0.05$.

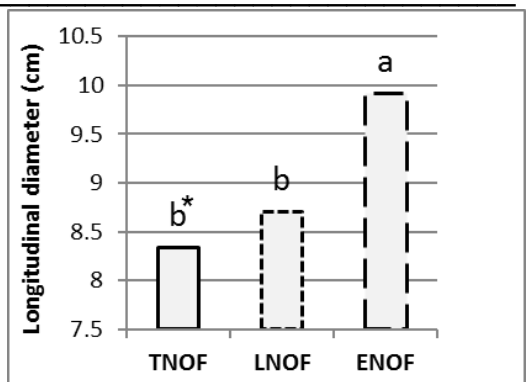
Results and Discussion

The Egyptian navel orange fruit (ENOF) showed significant superiority over the Libyan navel orange fruit (LNOF) and the Tunisian navel orange fruit (TNOF) in terms of weight and longitudinal and equatorial diameters (Fig.1, 2, 3). There were no significant differences between LNOF and TNOF. The equatorial diameter of fruits of all sources exceeded the minimum equatorial diameter required by international standard which is 53mm (Agricultural Standards Unit. 2011). According to recent studies, customer preference is for small, easy peeling seedless orange fruit (Kahn, *et al.*, 2007; Lacirignola and D'Onghia, 2009). This preference gives an advantage to LNOF which is of smaller size than ENOF. The ENOF exceeded the maximum desired USA orange fruit size which is 88mm (Kallsen, 2005). The longitudinal/equatorial diameter ratio (L/E) differed significantly among the three orange geographical sources (Fig. 4.).



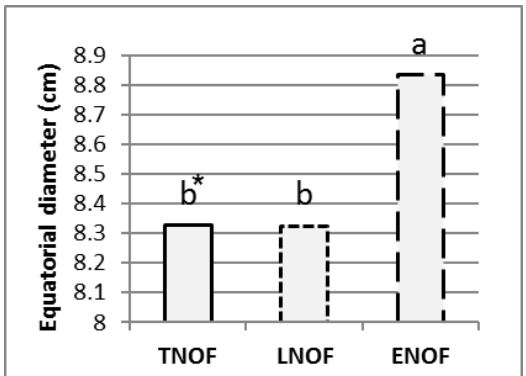
*Bars topped with different letters are significantly different according to Tukey's test at P <0.05.

Fig. 1. The average weight of navel fruit of the three sources



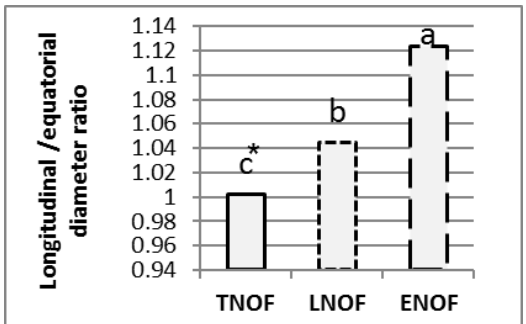
*Bars topped with different letters are significantly different according to Tukey's test at P <0.05.

Fig. 2. The average longitudinal diameter of navel fruit of the three sources.



*Bars topped with different letters are significantly different according to Tukey's test at P <0.05.

Fig.3. The average equatorial diameter of navel fruit of the three sources



*Bars topped with different letters are significantly different according to Tukey's test at P <0.05.

Fig.4 . The average longitudinal /equatorial diameter ratio of navel fruit of the three sources

TNOF was spherical with a ratio of 1.00, while LNOF and ENOF were elliptical with ratios of 1.04 and 1.12, respectively. This variable with addition of other fruit characteristics may help identify the geographical and genetic origin of orange fruit. Debbabi *et al.*, 2013 have previously studied L/E of 28 varieties of TNOF, which was found to be 0.96 (IPGRI., 1999; Kahn, *et al.*, 2007). ENOF exhibited granulation in the samples studied, while LNOF and TNOF were free from any granulation. This physiological disorder is related to the large fruit size as a result of many reasons. The most important factor contributing to large size fruit is over irrigation especially after the fruit set period (Kahn *et al.*, 2007; Kallsen *et al.*, 2011; Ritenour *et al.*, 2004).

The juice percentage of navel orange fruits showed significant differences among the three sources with 44.7% , 40.2%, and 34% for TNOF, LNOF, and ENOF, respectively (Fig. 5).All fruits exceeded the minimum limit (33%) of extractable juice that is required by the international legislations (Agricultural Standards Unit, 2011). Kallsen *et al.*, (2011) demonstrated that the percentage of juice weight to fruit weight was not affected by irrigation treatment. This excludes that the differences in the percentage of juice among the three orange sources were due to irrigation programs followed in the countries of studied navel oranges.

In this study, the percentage of juice content of ENOF was 34%. It was lower than what was found 44% and 46% by Serry (2010) for fruit harvested in 2007 and 2008, respectively.

TSS of LNOF was significantly higher than that from the other sources of navel orange (Fig.6.). TSS of TNOF was significantly higher than that of ENOF. The 10.25 value of TSS for ENOF was less than what has been found by some researchers. TSS of ENOF was 10.8 and 11.3 for the crops of 2010 and 2011, respectively (Hifny, *et al.*, 2012).

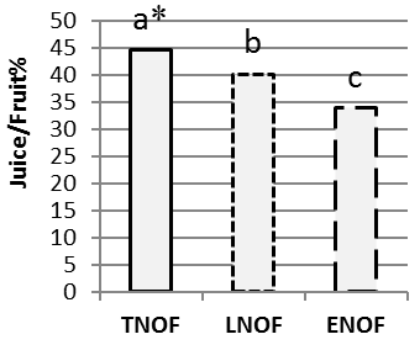


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Fig.5 . The average juice/fruit percentage of navel fruit of the three sources

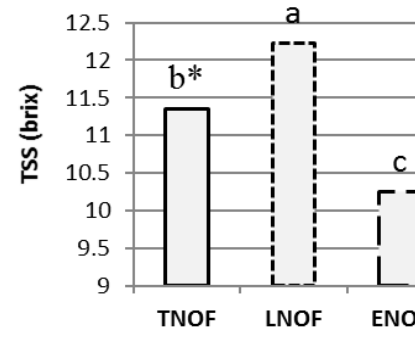

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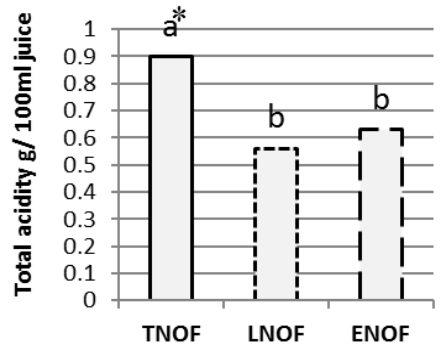
Fig.6 . The average TSS of navel fruit of the three sources

The Libyan Journal of AGRICULTURE. Volume (23), No. (1-2) 2018: 54-62

Juice TA of 0.9 g/100ml juice for TNOF was significantly higher than that of the other fruits sources, 0.55 and 0.63g/100ml juice for LNOF and ENOF respectively (Fig. 7). These values were higher than those of navel orange produced in California 0.4 and 0.5g/100ml juice (Kahn *et al.*, 2007). It is reported that TA orange fruit content decreases with exposure to temperature lower than freezing for some hours (Obenland *et al.*, 2003). The Tunisian producing area of navel orange is located in northern regions of the country distinguished by shorter and cooler summer compared with Libyan producing areas, causing a lower rate of fruit respiration and therefore less consumption of acids.

TSS/TA of the three navel orange sources were significantly different. LNOF had higher TSS/TA than that of the two imported sources (Fig.8.). The reason of the low ratio for the TNOF is attributed to high content of TA. All studied fruit sources exceeded the TSS/TA ratio enforced by international specifications that require ratios not less than 6.5. In this study, the TSS/TA ratio of ENOF was 16.51 which was higher than what Hifny *et al.*, (2012) found after two weeks of cold storage that the TSS/TA ratios for ENOF at harvesting were 8 and 8.2 for 2007 and 2008 crops, respectively (Serry, 2010). Obenland *et el.*, (2008) reported that TSS/TA ratio increased significantly during storage, mainly due to a decline in TA.



*Bars topped with different letters are significantly different according to Tukey's test at P <0.05.

Fig.7 . The average total acidity g/100 ml juice of navel fruit of the three sources

Acknowledgements

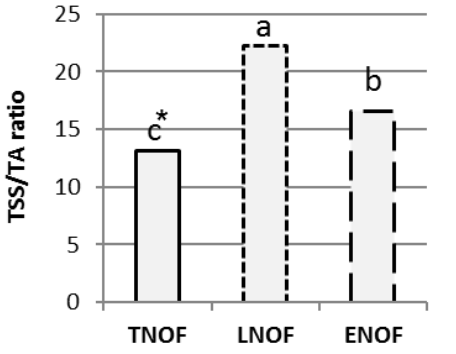


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Fig. 8. The average TSS/TA ratio of navel fruit of the three sources

We sincerely thank Dr. Abudalla Al-Tarhoni for the statistical analysis and Dr. Mongi Zekri, Dr. Mohammed Al-Tomzni and Dr. Saleh Al-Nuesry for their review of the manuscript.

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تقييم بعض صفات جودة ثمار برتقال أبو صرة الليبي والمستورد

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المستخلص

هَدَفَ البحثُ إلى استكشاف جودة ثمار برتقال أبو صرة الليبي والمستورد من مصر وتونس، والمتداولة في السوق الليبي، كذلك هدف البحث إلى استكشاف أي ميزات تفضيلية قد تكون كامنة في برتقال أبو صرة الليبي تمنحه ميزة تسويقية أو تنافسية في الأسواق المحلية والدولية.

أجري البحث بمختبر الفاكهة وفسيولوجيا ما بعد القطف بمركز البحوث الزراعية بطرابلس؛ حيث تم الحصول على عينات برتقال أبو صرة الخاصة بالتجربة من المصادر الجغرافية الثلاثة أسبوعيا كلما كان ذلك متاحا، من منتصف شهر يناير2014 إلى نهاية شهر مارس 2014. صُممت التجربة على أساس التصميم العشوائي الكامل (CRD)، وشملت الصفات المدروسة: وزن الثمار، وقطريها الطولي والاستوائي، والنسبة بينهما، ومحتواها من العصير القابل للاستخلاص، ونسبة المواد الصلبة الذائبة الكلية (TSS) بالعصير، ومحتواه من الحموضة الكلية (TA)، والنسبة بينهما، وتحبب الثمار.

أشارت النتائج المتحصل عليها إلى تفوق ثمار برتقال أبو صرة المصري معنويا في وزن الثمار وقطريها الطولي والاستوائي، والنسبة بينهما على نظيريتها الليبية والتونسية اللتين لم تُبديا فروقاً معنوية في هذه الصفات، إلا في النسبة بين القطرين؛ حيث تفوق برتقال أبو صرة الليبي على نظيره التونسي. أما بالنسبة لكمية العصير القابل للاستخلاص ومحتواه من (TSS) فقد ظهرت فروق عالية المعنوية بين مصادر البرتقال الثلاثة؛ حيث كان برتقال أبو صرة التونسي الأعلى في كمية العصير المستخلص يليه الليبي ثم المصري، بينما كان برتقال أبو صرة الليبي الأعلى في محتوى العصير من (TSS) يليه التونسي ثم المصري. تفوق برتقال أبو صرة التونسي في نسبة (TA) على الليبي والمصري اللذين لم يشهدا فرقاً معنوياً لمحتوى عصيرهما من (TA). أظهرت نسبة (TSS) إلى (TA) فروقاً معنوية بين مصادر البرتقال الثلاثة، كان أعلاها في برتقال أبو صرة الليبي يليه المصري ثم التونسي. أظهرت ثمار برتقال أبو صرة المصري تحبباً بينما كانت ثمار المصادر الجغرافية الأخرى خالية من أي تحبب.

يتضح من الدراسة وجود فروق تمييزية في بعض الصفات المهمة بين ثمار برتقال أبو صرة الليبي ونظيريه المستوردين؛ حيث تمتعت ثمار برتقال أبو صرة الليبي بقيمة عالية لنسبة (TSS) إلى (TA)، مما يعطيها مذاقاً تفضيلياً، إضافة إلى حجم يتوسط بين برتقال أبوصرة المصري والتونسي.

كلمات دالة : برتقال أبو صرة، المواد الصلبة الذائبة الكلية، عصير البرتقال، الحموضة الكلية.

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استلمت بتاريخ: 04 /4/ 2018 **أجيزت بتاريخ: 2018/10/01**