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A Study on the Nutritional Value of Hurma Olives (*Erkence cv.*) that Lose the Bitterness on the Tree

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ABSTRACT

Hurma olive (*Olea europea* L.) is known to be a product that is formed as a result of debittering that occurs in the fruits of Erkence olive cultivars leading the removal of the bitter taste in the olive when it is still on the tree and thus making the olive edible. "*Debittering*" is the term expressed as the maturation period occurring in the olive fruit while it is still on the tree. In this study, the aim was to harvest Hurma olives from different locations of the Karaburun peninsula in order to determine the nutritional value. For this purpose, measurements were carried out on samples in order to determine their oil (%), protein (%), total sugars (%), reduced sugar (%), starch (%), energy (kcal 100 g^{-1}), pH, total phenolic compound (mg cafeic acid equivalent (CAE) 100 g^{-1}), mineral element (N, P, K, Ca, Mg, Fe, Mn, Zn, Cu, B) contents. Besides, new harvested Hurma olives and dry salted ones stored for 1 year, that had been collected from three different locations of the peninsula, were compared in terms of some chemical properties. Hurma olives were determined to have 38.63% oil, 1.2% protein, 0.52% total sugar, 1.24% starch and the pH value of 5.52. They are regarded as a good source of energy due to the considerably higher oil (359.8 kcal 100 g^{-1}), phenolic compounds (288.71 mg CAE 100 g^{-1}) and mineral element content. It was found out that Hurma olives had high values in terms of mineral element content (N 0.57%, P 0.12%, K 1.42%, Ca 0.09%, Mg 0.04%, Fe 61.44 mg kg^{-1}, Mn 5.23 mg kg^{-1}, Zn 6.40 mg kg^{-1}, Cu 5.53 mg kg^{-1}, B 21.27 mg kg^{-1}) as well. The effects of the salt applications on phenolic compound and reduced sugar content of the olive samples was found statistically insignificant ($P>0.05$). According to the results obtained, the consumption of Hurma olive might be considered to be beneficial for human health due to its salt-free composition, nutritive compounds, total phenolic compound content and the amount of energy it provides.

Keywords: Hurma olive; Erkence; Total phenolic compound; Nutrient composition; Dry salted; Hypertension

Ağaç Üzerindeyken Acılığı Uzaklaşan Hurma Zeytinlerin (*Erkence cv.*) Besin Değeri Üzerine Araştırma

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ÖZET

Hurma zeytin (*Olea europaea* L.), Ege Bölgesi'nde Karaburun Yarımadası'nda Erkence zeytin çeşidinin meyvelerinin ağaç üzerindeyken acılıklarının kaybolarak yenebilir hale gelmeleri sonucu oluşan ürün olarak bilinmektedir. Ağaç üzerindeki bu süreç "Hurmalaşma" olarak ifade edilir. Bu çalışmada, tuzsuz olması nedeniyle sağlık sorunları yaşayan kişiler için önemli bir besin kaynağı olan Hurma zeytinin, yarımadanın farklı bölgelerinden hasat edilerek besin değerinin ortaya konması amaçlanmıştır. Bu amaçla yağ (%), protein (%), toplam şeker (%), indirgen şeker (%), nişasta (%), enerji (kcal 100 g^{-1}), pH, toplam fenolik madde miktarı (mg kafeik asit eşdeğeri (CAE) 100 g^{-1}), mineral madde (N, P, K, Ca, Mg, Fe, Mn, Zn, Cu, B) analizleri gerçekleştirilmiştir. Ayrıca aynı bölgedeki üç noktadan alınan örneklerde sele tipi bir yıl muhafaza edilmiş ve yeni hasat edilmiş Hurma zeytinlerin bazı kimyasal özellikleri bakımından karşılaştırılması yapılmıştır. Hurma zeytinlerin % 38.63 yağ, % 1.2 protein, % 0.52 toplam şeker, % 1.24 nişasta içerdiği, 5.52 pH değerine sahip olduğu belirlenmiştir. Yüksek yağ içeriğinden dolayı iyi bir enerji kaynağı (359.8 kcal 100 g^{-1}) ve aynı zamanda toplam fenolik madde içeriği (288.71 mg CAE 100 g^{-1}) yüksek bir besin olduğu tespit edilmiştir. Hurma zeytinlerin mineral madde içeriği (N % 0.57, P % 0.12, K % 1.42, Ca % 0.09, Mg % 0.04, Fe 61.44 mg kg^{-1}, Mn 5.23 mg kg^{-1}, Zn 6.40 mg kg^{-1}, Cu 5.53 mg kg^{-1}, B 21.27 mg kg^{-1}) bakımından da yüksek değerlere sahip olduğu belirlenmiştir. Hurma zeytinlerin toplam fenol ve indirgen şeker içeriği üzerinde tuz uygulamalarının etkisi önemsiz bulunmuştur ($P>0.05$). Bu bilgiler ışığında, içermiş olduğu temel besin maddeleri, toplam fenolik madde ve enerji miktarı ile birlikte özellikle tuzsuz olarak tüketilmesi açısından Hurma zeytin tüketiminin sağlık için önemli olduğu söylenebilir.

Anahtar Kelimeler: Hurma zeytin; Erkence; Toplam fenolik madde; Besin kompozisyonu; Sele; Yüksek tansiyon

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1. Introduction

Olive fruit does not differ from the other stone fruits morphologically. However, it differs from the other fruits due its low sugar content, high oil content and bitter taste that is formed by oleuropein (Balatsouras 1997). Olive fruit contains high amount of phenolic compounds. Oleuropein is the main phenolic compound existing in the pulp fraction of the olive fruit (Ryan et al 1999; Omar 2010). The bitter taste, that oleuropein is responsible for, is a factor inhibiting the olive fruit to be consumed directly. For this reason, oleuropein needs to be removed from the fruit with the application of several processes. Salt is commonly used in the processing of table olives or in the preservation of the processed olives. This constitutes a significant importance for the individuals that need to regulate salt intake in their diets. The World Health Organization, that carries out comprehensive studies intended for reducing the salt consumption, declares that the salt intake per day should not be more than 5 g (2 g sodium) in order to prevent chronic diseases (WHO 2006). There are some olive varieties in Karaburun Peninsula, Turkey that turn into edible form losing its bitter taste spontaneously while they are on the tree. The phenomenon occuring in the fruit on the tree is called "Debittering" and the olive obtained this way is called "Hurma Olive" (Susamcı 2011). Since Hurma olive is not a processed product and thus it does not contain salt, it has turned out to be a suitable option for the individuals seeking for salt-free olives. Hurma olives, which have all the mentioned properties, is the main source for the people living around Karaburun Peninsula to make money for living. Debittering is reported to occur commercially only in Izmir/Karaburun Peninsula and only for the olive cultivar *Erkence* in the world (Tutar 2010). Besides, some olive cultivars in Tunisia and Greece have been reported to have similar characteristics (debittering) to Erkence (Panagou 2006; Jemai et al 2009). Erkence is one of the most important olive cultivar for oil and table olive production around Izmir. This cultivar represents a medium rate of productivity, strong alternate bearing and early harvest characteristics (Mete & Cetin 2006). Debittering is reported to be depending on climate conditions (Buzcu 1969; Pamuk 1993) and soil characteristics (Tutar

2010). Besides, it is stated that a fungus named *Phoma oleae* is effective on the hydrolysis of oleuropein (Panagou 2006). The formation of Hurma olive on tree is reported to be related to the change in the phenolic compound composition and to the decrease in the phenolic compound content. Especially, the differences in the phenolic compound composition observed in the late phase of the maturation period of Hurma olives, non-debittered Erkence and Gemlik olive cultivars constitute a significant effect on debittering (Aktas et al 2013). If Hurma olives cannot be sold in a short period of time right after harvesting, the producers begin to store the olives after treating them with salt and this treatment causes Hurma olives to lose their salt-free characteristic. It is stated that Hurma olives might be preserved in modified atmosphere conditions at 1 ºC up to 90 days without representing any flavor change (Susamcı 2011).

In this study, nutritive contents of Hurma olive samples that had been collected from different locations of Karaburun Peninsula were determined. Besides, new harvested Hurma olives and the ones harvested a year ago and then preserved as dry salted Hurma olives were compared in terms of chemical properties.

2. Material and Methods

In this study, Hurma olive (salt-free) samples were freshly harvested from different locations of Karaburun Peninsula in November, 2010 (T_0) for the evaluation of nutritional composition and mineral element content. Besides, from only three locations, dry salted Hurma olive samples stored in closed plastic containers for 1 year were also used as materials (T_1). The samples were collected in duplicates and immediately transferred to the laboratory.

In order to determine the oil content in the olive samples, 10 g of sample was weighed on a coarse filter paper and was dried at 105 °C for 4.5 h. The dried samples were placed on a cartridge with the filter paper and the oil contents were determined through extracting the samples with n-hexane in the Soxhelet extraction device for 8 h according to the method given in IUPAC (1990). The oil contents were given as percentage (%). To determine the protein content of olive samples, crushed and homogenized olive sample of 0.25 g was weighed on aluminium folio, then it was kept for 3 minutes in nitrogen/protein analyzer (LECO FP-528, Michigan, USA) at 900 ºC. Protein content was calculated by multilying nitrogen value with 6.25 factor and results were expressed as % (AOAC 2005). Reduced sugar contents in the olive samples were determined according to Luff-Scroll method and given as percentage (%) (Uylaşer & Başoğlu 2000). Afterwards, supernatant obtained by Luff-Scroll method was used to determine total sugar content (TKB 1988). In the reduced sugar analysis, pitted and homogenized olive sample of 5 g was mixed with 5 mL potassium ferro cyanide (15%) and 5 mL zinc sulfate (30%) solutions. Afterwards, the mixture was made up to 100 mL with distilled water and set aside for a night in a closed lid sample container. The sample mixture was filtered on the next day and 25 mL Luff solution was added to the filtrated solution. The solution was boiled for 10 min in a heater condenser. Then, 10 mL potassium iodate, 25 mL sulphuric acid (25%) and a few drops of starch solution (5%) was added to the expeditiously cooled sample solution. The solution was titrated with 0.1 N sodium thiosulphate solution until the color of the solution turned into creamy yellow. Reduced sugar which consumed to sodium thiosulphate was read to related table in method. The results were calculated considering the volume of the titration solution consumed for the blank sample and the dilution carried out. In order to determine total sugar content, 50 mL of the clear supernatant (set aside for a night and filtered) obtained during reduced sugar analysis was taken into a 100 mL volumetric flask and 5 mL of hydrochloric acid was added. The solution was shaken in the water bath at around 70 °C for 5 min. Therefore, all sugars in solution were converted to reduced sugar by inversion treatment. Then it was cooled down to 20 °C and notralized with sodium hydroxide until the pH value reaches to 6.0. The solution was filled

to the volume with distilled water and mixed. 5 mL of this solution was taken and followed steps as it was performed in reduced sugar analysis after addition of Luff solution. Results were expressed as percentage (%). Starch content was measured with a polarimeter and expressed as percentage (%) (TKB 1988). For this purpose, crushed olive sample of 5 g was weighed on 100 mL flask and twice extracted with 25 mL of 1% HCl by shaking. This solution was kept on the boiling bath for 15 minutes and then, added 30 mL of distilled water and cooled. Compounds which comprise of nitrogen were precipitated with 10 mL of Wolfram acid and flask was filled to 100 mL with distilled water. After solution was filtered, supernatant was taken to polarimeter tube and measured its polarization. Starch content was calculated according to Equation 1. Energy value per 100 g was calculated according to Equation 2 and indicated as kcal.

$$\text{Starch content (\%)} = (100 \times a \times 100) / ((\alpha)\, D^{20} \times l \times 5) \quad (1)$$

Where; a, polarization degree read on polarimeter; (α) D^{20}, 182.7 (polarization degree of starch of wheat according to Ewers method); l, length of polarimeter tube (dm).

$$Energy(kcal) = (Oil\% \times 9) + ((Total\ sugar\% + Starch\%) \times 4) + (Protein\% \times 4) \quad (2)$$

pH values in the fruit pulp were measured with a pH-meter on 50 g of olive dough that had been prepared with pitted and homogenized in blender (TSE 2003).

Total phenolic compound content was determined with a spectrophotometer (UV2450, Shimadzu, Japan) utilizing the sample preparation method that Günç Ergönül (2006) had used. Calibration curve was obtained using the standard solutions in different concentrations prepared from cafeic acid stock solution. One g of homogenized olive sample mixed with 5 mL of methanol:water (60:40) solution for 2 min. Then, it was centrifuged at 3500 rpm for 10 min. The supernatant was taken into a 10 mL sample tube filtering through a coarse filter paper and the precipitate was washed with methanol-water solution, centrifuged and filtered. The filtered sample in 10 mL sample tube was made up to the volume with distilled water. Once the sample was well mixed, 0.1 mL was taken into 50 mL volumetric flask and 5 mL of distilled water and 0.5 mL Folin-Caiocalteu reagent were added. The solution was stood for 3 min and 1 mL of 36% Na_2CO_3 solution was added. Then, the sample solution was made up to the volume with distilled water. After the solution was kept in the dark for 2 h, the absorbance values were read at 725 nm wavelength using UV/VIS Spectrophotometer. The concentration values that correspond to the absorbance values were determined in the calibration curve for each sample and the results were calculated as mg CAE 100 g^{-1} considering the dilution factor.

Salt content in fruit pulp was determined with the titration of 10 g olive sample, which was pitted and homogenized, with 0.1 N silver nitrate and expressed as percentage (%) (TSE 2003).

Mineral element contents of the samples were also measured in the some locations. For this, 0.3 g of the sample was weighed into the digestion tube and, 5 mL of concentrated nitric acid and 2 mL of hydrogen peroxide were added. Samples were digested in a laboratory microwave oven for 5 minutes at 200 psi at 180 ºC, for 10 minutes at 200 psi at 240 ºC. Solutions were made up to 15 mL with distilled water. After standards were read for calibration of every mineral, samples were read by using ICP-OES (inductively coupled plasma optical emission spectrometry). Results were calculated by concidering dilution factor and were expressed as percentage (%) for macro and mg kg^{-1} for micro nutrients (NMKL 2014).

The data from the newly harvested Hurma olives were subjected to one way ANOVA, whereas for the comparison of of newly harvested and salted hurma olives, a split plot design, where year was the main, and location was the sub plots, was used. A statistical package (JMP for Windows ver. 5.1) was used for both statistical analyses and the differences between the means were determined with Student's t test. Mineral element contents were not compared statistically.

3. Results and Discussion

Results of the oil, protein, total sugar, starch, energy, pH, and total phenolic compound contents for the harvested Hurma olives were given in Table 1. Oil content values varies between 33.83% and 42.26%. Although Hurma olive is generally consumed as table olive, it was determined that Hurma olive had higher amount of oil than olive oil cultivars. The amount of the Hurma olives processed for oil production is also quite much in the region. The oil content of Hurma olive, which is around 38.63%, enhances its nutritive value and makes it more valuable. Some of the important olive cultivars produced in Turkey such as Memecik, Ayvalık, Domat, and Gemlik contain oil in the amounts of 26%, 26%, 22%, and 28%, respectively. When compared to these cultivars, it is obviously seen that Hurma olive is a good source of oil (Günç Ergönül 2006). Another study has reported that there is no significant difference between the oil contents and the oil quality characteristics of the debittered fruits and non-debittered fruits of Erkence olive cultivar (Sevim et al 2013).

Protein contents were determined between 0.89% and 1.45%. Olives generally contain protein in the amount of 1-2% changing depending on the variety (Garrido Fernandez et al 1997), for instance unprocessed Memecik olives in the black mature form contain 1.31% protein (Ünal & Nergiz 2003). Although olives have low protein content, that low value is important due to the essential amino acid composition. It was observed that Hurma olives contain similar amount of protein that of the other olive cultivars.

Total sugar content differs between 0.18% and 1.05%. Reduced sugar content in the table olives before processing is reported be around 3-6% (Garrido Fernandez et al 1997). Total sugar content of the unprocessed Memecik olives in the black mature form is reported to be 2.20% and the reduced sugar content is reported as 1.90% (Ünal & Nergiz 2003). When compared to these information in literature, the results obtained shows that the sugar content of the olive decreases during debittering on tree. Tuna (2006) stated that total sugar content comprise of highly reduced sugars in olive. These sugars are indicated to be increasing the acidity level in the media as a result of being converted to lactic acid by homofermentative bacteria or to lactic acid, acetic acid, and some other metabolites by heterofermentative bacteria. It might be stated that the sugars in the olive are used by the microorganisms during debittering. Inconsistency between total sugar and reduced sugar values for Çamtepe (T_0) may be explained with differences among Hurma olive fruits due to naturally debittering (Susamcı 2011).

Table 1- Comparison of the some properties of the new harvested (salt-free) Hurma olives collected from different locations in Karaburun Peninsula (mean±standard deviation)

Çizelge 1- Karaburun Yarımadası'nda farklı noktalardan yeni hasat edilen (tuzsuz) Hurma zeytinlerin kimi özelliklerinin karşılaştırılması (ortalama±standart sapma)

Location	*Oil (%)*	*Protein (%)*	*Total sugar (%)*	*Starch (%)*	*Energy (kcal 100 g^{-1})*	*pH*	*Total phenolics (mg CAE 100 g^{-1})*
Ambarseki-1	33.83±0.33 c*	1.45±0.10 a	0.36±0.11 cd	1.20±0.07 b	316.5±2.8 c	5.41±0.11 c	288.93±119.11
Çamtepe	42.26±1.00 a	1.32±0.14 ab	0.45±0.06 c	2.19±0.06 a	396.2±9.6 a	5.70±0.03 b	282.40±76.01
Eğlenhoca	35.80±1.16 bc	1.24±0.06 ab	0.18±0.08 d	1.20±0.01 b	334.6±7.1 b	5.87±0.04 a	282.23±37.51
Gödence	41.80±0.94 a	1.18±0.20 ab	0.36±0.03 cd	0.44±0.03 c	384.1±7.9 a	5.67±0.04 b	299.35±48.65
Kösedere	41.40±0.82 a	1.13±0.04 bc	0.72±0.08 b	1.20±0.17 b	384.8±8.6 a	5.57±0.03 b	290.63±33.41
Urla	36.68±0.36 b	0.89±0.08 c	1.05±0.07 a	1.20±0.11 b	342.9±4.1 b	4.88±0.06 d	nm
Mean	38.63	1.20	0.52	1.24	359.8	5.52	288.71

*, different letters in the same column are significant (P<0.05); nm, not-measured

The starch content in the olive samples were determined between 0.44% and 2.19%. The energy values of the Hurma olive samples were also found high due to their high content of oil. Energy values differ between 316.5 kcal and 396.2 kcal for 100 g. Hurma olives were found to have higher values in terms of starch in Çamtepe and in terms of total sugar in Urla when compared to the values of the olive samples harvested from the other locations. Hurma olives might be classified in the group of foods having medium level of acidity and their pH values were determined between 4.88 and 5.87 in this study. Due to high pH and salt-free, Hurma olives have more sensitive to spoilage in short time after harvesting (Susamci 2011).

The phenolic compound contents of the Hurma olive samples were found to be between 282.23 and 299.35 mg CAE 100 g^{-1}. The phenolic compound content of the olives are affected by factors such as variety, maturation period, cultivation locations, seasonal climate changes, and agricultural applications (Patumi et al 2002; Marsilio et al 2005; Vinha et al 2005). In a study that Hurma olives were observed during 2 years, it was reported that the total phenolic compound content of the olives during debittering period in the first year was around 337.7-649.6 mg gallic acid equivalent (GAE) 100 g^{-1}, whereas it was found between the range of 29.2-344.3 mg GAE 100 g^{-1} in the second year. In the same study, it was stated that the natural debittering phenomenon of Hurma olive on the tree involves a decrease in phenolic content and a change in phenolic composition. Even though Hurma olive and Erkence belong to the same variety, the phenolic compound content of Hurma olives were found lower when compared to the phenolic compound content of Erkence (Aktas et al 2013). Zoidou et al (2010) reported that olives processed as dry salted contained significant amount of oleuropein (1.2 mg $fruit^{-1}$). Considering that a person can consume 20 olive fruit per day, approximately of 25 mg of oleuropein per day might be taken as safely for human use. Boskou et al (2006) determined between 82 and 145 mg CAE 100 g^{-1} the phenolic compound content of five different Greek olive cultivars purchased from the local market in Athens and they reported that 5-10 table olives might cover the daily intake of polyphenols. Similarly, it might be suggested to consume 5-6 Hurma olives, that are rich in phenolic compounds, per day as an antioxidant source. Phenolic compounds have significant benefits on human health and Hurma olives might be regarded as a rich source of phenolic compounds. Saija & Uccella (2001) pointed out that the risk of having chronic diseases are comparatively lower in the societies where based on the Mediterranean aliment culture. Total phenolic compound content, pH, and reduced sugar values of the new harvested Hurma olives and of the ones stored for 1 year were shown in Table 2. The salt contents of the dry salted Hurma olives were also listed in Table 2. The salt content of the Hurma olives that had been stored as dry salted for 1 year was determined as 6.98%. Total phenolic compound content of the salt-free Hurma olives (T_0) were determined as 290.79 mg CAE 100 g^{-1}, whereas the mean value of the total phenolic compound content for the Hurma olive samples that had been stored as dry salted olives (T_1) was 344.33 mg CAE 100 g^{-1}. 11.20% loss in the phenolic compound content of the Gemlik cultivar was reported after processed with trundle method (before processing 274.91 mg CAE 100 g^{-1}, after processing 244.10 mg CAE 100 g^{-1}) (Irmak et al 2010). The phenolic compound of the dry salted Hurma olives was comparatively higher when compared to the new harvested ones, even though they had been stored for 1 year. This might be a result of the difference in the climate between years. The mean pH value of the Hurma olives preserved as dry salted was determined as 4.71, whereas the mean pH value of the new harvested Hurma olives was found as 5.65. The effect of the salt application on pH values of the olive samples was found statistically significant ($P<0.05$). In the dry salt media, it might be stated that the acidity of the Hurma olives increased due to fermentation. The mean values for the reduced sugar contents were determined as 0.52% for both new harvested Hurma olives and the dry salted ones stored for 1 year. The effect of the location x salt application interactions on the reduced sugar contents of the olives were found significant

(P<0.05). Özay & Borcaklı (1996) reported in their study, that they had aimed at producing high quality black olive with natural fermentation, that reduced sugars had been efficiently consumed by microorganisms and the amount of the residues had been changing between 0.05-0.1 g 100 mL^{-1}. As reported by Garrido Fernandez et al (1997) that raw olives contain around 3-6% reduced sugars, it can be said that Hurma olives have reduced sugar content similar to olives processed with natural fermentation.

The mineral element contents of the Hurma olives are given in Table 3. The mineral element content (excluding nitrogen and iron) of the olive samples collected from Eğlenhoca were found higher than the mineral contents of the olive samples collected from the other locations. It was reported that the mineral element content of the olives (Ca, K, Fe, Zn) was affected by industrial processes and storage. Since the olives are treated with salt during processing, sodium content in the olive fruit was reported to increase after processing whereas calcium, potassium, zinc contents decreased and iron content value was flactuating. When the mineral contents of Hurma olives were compared to the values of Memecik cultivar olives when they are green, brownish and black in their mature period, it was found out that the Hurma olives contained higher amounts of potassium, calcium, iron and zinc (Ünal & Nergiz 2003). Average value of boron in Hurma olives was found as 21.27 mg kg^{-1}.

Table 2- Comparison of some chemical characterstics of the new harvested Hurma olives (T_0) and the dry salted Hurma olives (T_1) stored for 1 year (mean±standard deviation)

Çizelge 2- Yeni hasat edilmiş (T_0) ve sele tipi bir yıl muhafaza edilmiş (T_1) Hurma zeytinlerin bazı kimyasal özelliklerinin karşılaştırılması (ortalama±standart sapma)

Location		*Salt in fruit pulp (%)*	*Total phenolic compound (mg CAE 100 g^{-1})*	*pH*	*Reduced sugar (%)*
Çamtepe.	T_0		282.40±76.01	5.70±0.03	0.72±0.06 a*
	T_1	7.61	348.50±18.88	4.79±0.03	0.38±0.04 c
Gödence.	T_0		299.35±48.65	5.67±0.04	0.32±0.04 c
	T_1	7.37	368.85±24.96	4.80±0.03	0.67±0.03 a
Kösedere.	T_0		290.63±33.41	5.57±0.03	0.51±0.06 b
	T_1	5.97	315.63±19.83	4.54±0.06	0.50±0.06 b
Mean	T_0		290.79	5.65 a	0.52
	T_1	6.98	344.33	4.71 b	0.52

*, different letters in the same column are significant (P<0.05); T_0, new harvested Hurma olive; T_1, dry salted Hurma olive that had been stored for 1 year

Table 3- Mineral element contents of the new harvested (salt-free) Hurma olives from different locations of Karaburun Peninsula

Çizelge 3- Karaburun Yarımadası'nda farklı noktalardan yeni hasat edilen (tuzsuz) Hurma zeytinlerin mineral madde içerikleri

Location	*N (%)*	*P (%)*	*K (%)*	*Ca (%)*	*Mg (%)*	*Fe (mg kg^{-1})*	*Mn (mg kg^{-1})*	*Zn (mg kg^{-1})*	*Cu (mg kg^{-1})*	*B (mg kg^{-1})*
Ambarseki-1	0.43	0.09	1.00	0.06	0.03	19.68	2.99	4.84	3.65	12.28
Ambarseki-2	0.39	0.14	1.18	0.08	0.04	88.18	5.32	6.50	5.06	20.90
Tepe Bozköy	0.67	0.09	1.29	0.08	0.03	12.26	3.66	5.28	5.47	21.60
Eğlenhoca	0.48	0.18	2.64	0.15	0.07	60.53	8.20	9.04	10.93	37.04
Kösedere	0.77	0.08	1.15	0.09	0.03	56.82	4.58	5.15	3.67	20.00
Saip	0.65	0.11	1.26	0.09	0.04	131.14	6.65	7.56	4.41	15.78
Mean	0.57	0.12	1.42	0.09	0.04	61.44	5.23	6.40	5.53	21.27

4. Conclusions

The results showed that Hurma olives contained protein, sugar and starch in balanced amounts in addition to its high oil content. It represents similar characteristics with the other olive cultivars and provides high amount of energy due to its high oil content. It was determined that Hurma olives contained important amount of phenolic compound content, when it is considered as if it was the processed table olives due to naturally debittering. In this regard, Hurma olive is a good source of energy and phenolic compounds. The mineral element content of Hurma olives (K, Ca, Fe, Zn) are comparatively higher than the mineral element content values of Memecik cultivar olives both before and after processing (Ünal & Nergiz 2003). The possible consumption of Hurma olives right after harvested from the tree can compensate for the some of the natural nutrients needed by the human metabolism. It was concluded that the difference between the chemical properties of the new harvested and dry salted samples stored for 1 year was due to the changes in climate between years and the salt concentration in the media. Considering the olive processing methods decrease the phenolic compound content (Irmak et al 2010), dry salted Hurma olives would be expected to have a lower phenolic compound content. However, the results obtained showed an opposite trend. This trend might be originated from effect of factors like climate or differences between Hurma fruits. There is a little differences among Hurma olives (new harvested) in terms of texture, taste due to naturally debittering (Susamcı 2011). Besides having considerable amount of phenolic compounds, Hurma olives constitute an importance in terms of consumer health due to its salt-free characteristic.

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