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Erkenci Nektarın, Şeftali ve Kayısı Çeşitlerinin Bazı Fiziko-Kimyasal Özellikleri ve Antioksidan Kapasiteleri

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Özet

Bu araştırmada, Mersin ilinde yetiştirilen erkenci nektarin, şeftali ve kayısı türlerine ait çeşitlerin meyve ağırlığı, çekirdek ağırlığı, meyve eni, meyve boyu, meyve indeksi, toplam suda çözünebilir kuru madde (SÇKM), pH, titre edilebilir asitlilik (TA), SÇKM/TA ve meyve suyu randımanı gibi bazı fizikokimyasal özellikleri araştırılmıştır. Elde edilen değerler Flanoba nektarin çeşidi için sırasıyla 110.076 g, 7.463 g, 78.285 mm, 75.600 mm, 0.991, %7.300, 4.067, %0.744, %9.807 ve %66.468; Francoise şeftali çeşidi için 116.781 g, 5.361g, 79.501mm, 79.869 mm, 0.998, %9.033, 4.100, %0.528, %17.121, and %65.765 ve Ninfa kayısı çeşidi için ise 44.866 g, 6.587 g, 60.770 mm, 62.371 mm, 1.006, %8.800, 4.333, %1.016, %8.659, ve %65.611 olmuştur. Bununla birlikte meyve kabuk rengi ölçüm değerleri olan L, a ve b sırasıyla Flanoba nektarin çeşidi için 38.514, 30.185, 16.621; Francoise şeftali çeşidi için 50.639, 15.556, 20.016 ve Ninfa kayısı çeşidi için ise 52.628, 6.669 ve 23.927 olarak elde edilmiştir. Meyve çeşitleri antioksidan aktiviteleri açısından karşılaştırıldığında, Flanoba nektarin çeşidi en yüksek değerleri göstermiştir.

Anahtar Kelimeler: *Nektarin, şeftali, kayısı, fiziko-kimyasal özellikler, antioksidan aktiviteleri*

Some Physico-Chemical Properties and Antioxidant Capacities of Early Maturing Nectarine, Peach and Apricot Cultivars

Abstract

In this study, some physico-chemical properties in terms of fruit weight, seed weight, fruit width, fruit length, fruit length/width, total soluble solids (TSS), pH, titratable acidity (TA), TSS/TA and fruit juice yield in early maturing nectarine, peach and apricot cultivars are assessed in Mersin region. Obtained values were respectively 116.781 g, 5.361g, 79.501mm, 79.869 mm, 0.998, 9.033%, 4.100, 0.528%, 17.121%, 110.076 g, 7.463 g, 78.285 mm, 75.600 mm, 0.991, 7.300%, 4.067, 0.744%, 9.807% and 66.468% for Flanoba nectarine; 65.765% for Francoise peach and 44.866 g, 6.587 g, 60.770 mm, 62.371 mm, 1.006, 8.800%, 4.333, 1.016%, 8.659%, and 65.611% for Ninfa apricot. However, determinated L, a, and b values considered for fruit peel color measurements are respectively 50.639, 15.556, and 20.016 for peach; 38.514, 30.185, and 16.621 for nectarine; and 52.628, 6.669 and 23.927 for apricot. However, determinated L, a, and b values considered for fruit peel color measurements are respectively 50.639, 15.556, and 20.016 for peach; 38.514, 30.185, and 16.621 for nectarine; and 52.628, 6.669 and 23.927 for apricot. When antioxidant activities of fruit cultivars in the experiments compared, Flanoba nectarine cultivar was showed the highest values.

Key Words: *Nectarine, peach, apricot, physico-chemical properties, antioxidant activities*

Introduction

Some types of vegetables and fruits in general protect against some cancer types. Since fruits and vegetables happen to be good sources of antioxidants (which are substances that may protect cells from the damage caused by unstable molecules known as free radicals), this suggested that antioxidants might prevent some types of diseases (Stanner et al. 2004).

Recently, some studies have been published about some physico-chemical properties and antioxidant activity of nectarine, peach and apricot fruits. Byrne et al. (2004) reported that stone fruits contain a range of natural chemicals and pigments (phenolic compounds, ascorbic acid, vitamin E and carotenoids), which are thought to be beneficial in improving human health. On the other hand, the bioactive content of fruits varies probably due to growing at different climate and soils. Therefore, attention has more recently been focused on assessing the distribution on biologically active compounds among different varieties which are grown in Mersin ecological conditions.

The main aim of this study was to evaluate the influence of cultivar on physico-chemical parameters and antioxidant activity examined with the different antioxidant assays including free radical scavenging activity, Fe^{2+} chelating activity (%) and H_2O_2 inhibition

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activity of Flanoba nectarine, Francois peach and Ninfa apricot fruit cultivars.

Materials and Methods

Materials

Early maturing nectarine (Flanoba), peach (Francoise) and apricot (Ninfa) fruit (Figure 1) cultivars were obtained from Ozluce-Tarsus-Mersin-Turkey (NL 36º 59′ 55.78″; EL 35º 02′ 42.28″, its elevation is 166 feet (50.5968 meters) in the May 2010 season. All the cultivars are early maturing cultivars in terms of fruit maturing. Fruit samples were taken from 4 years old trees and the soil structure were clay-loam. Planting range were 3.5x3.5 m for Ninfa cultivar; 3 x 4 m for Francoise and Flanoba cultivars.

Nectarine "Flanoba" Peach "Francoise" Apricot "Ninfa"

Figure 1. Studied stone fruit cultivars in the research

Methods

Physico-chemical analysis

Sampling: Ten fruits of each treatment were used for all analysis.

Determination of fruit mass: Fruit weight was measured by an electronic balance with an accuracy of 0.01 g. Each measurement was replicated 10 times.

Determination of seed weight: Fruit seed weight was measured by an electronic balance with an accuracy of 0.01 g. Each measurement was replicated 10 times.

Determination of size: From the samples, 10 fruits were selected at random for determining the physical characteristics. For each fruit, length and width values were measured using a digital calliper.

pH: The pH value was measured using a digital pH meter.

Titratable acidity (TA): Titratable acidity, expressed as % of malic acid, was determined in 10 ml of juice plus 50 ml of distilled water by titration to pH 8.1 with 0.1 N NaOH.

Total soluble solids (TSS): The total soluble solids (TSS), expressed as %, was determined in the juice of each sample using a portable refractometer at 21ºC.

TSS/TA: The ratio was found to divide the total soluble solid concentration by the total acid concentration.

Fruit juice yield: Juice yield, expressed as %, was calculated as the ratio of the weight of extracted juice to the total weight of the extracted juice and the residual products after extraction.

Color: Fruit color was evaluated by measuring Hunter L (brightness, 100 = white, 0 = black), a (+, red; -, green) and b (+, yellow; -, blue) parameters by means of a reflectance colorimeter (CR 300, Chromometer, Minolta, Japan). A white tile (No: 21733001) was used to standardize the instrument.

Preparation of extracts for antioxidant activities: About 2.5 g fresh fruit samples were extracted by homogeny in mixer (Ultra turrax) with 50 ml solvent (50% water-methanol). The extracts were centrifuged at 4.000 x g for 3 min at 4°C after draining on coarse filter paper. And then the filtrate was drained by blue band filter paper (no: 391) (Ersoy et al. 2010).

Free radical scavenging effect: The radical scavenging activity against the DPPH (diphenylpicrylhydrazyl) radical was evaluated according to the method of Serteser et al. (2008), with some minor modifications. The assay mixture contained 1.5 ml of 0.09 mg/ml DPPH (Sigma Chemical Co., St Louis, MO, USA) in methanol, 1 ml acetate buffer solution (100 mM, pH 5.5). The dilutions between 0.4 and 4 mg/ml were prepared with methanol. Then 3.9 ml DPPH solution prepared with $6x10^{-5}$ M methanol was added to each 0.1 ml dilution and shaken well. The mixture was prepared and incubated for 60 min at room temperature in the dark. The absorbance of the remaining DPPH was determined at 517 nm against a blank. The scavenging activity was expressed as the IC_{50} value (mg/ml). All analyses were carried out twice.

Linear regression equations of absorbance against concentrations were determined by measuring the absorbances of seven different concentrations of

DPPH ($6x10^{-5}$ M) stock solution: A (517 nm)=15.465 (C DPPH)-0:0187 (R^2=0.987)

The remaining DPPH concentrations against absorbance values of sample series of different concentrations were calculated and then the remaining DPPH percentage was calculated:

% Remaining DPPH=[DDPH] sample/[DPPH] control

Exponential regression equation was obtained between the rate of the remaining DPPH percentage and the DDPH amount of sample in vitro, and the sample concentrations of plants that decrease the initial DPPH concentrations by 50% (efficient concentration [EC_{50}]). The antiradical activity (AE) was calculated by dividing EC_{50} values into 1.

Fe^{2+} chelating activity: The modified methods of Lim and Murtijaya (2007) were used for determination of the Fe^{2+} chelating activities of samples. One milliliter of extracts with different concentrations between 6 and 45 mg/ml and 3.7 ml deionizer water were mixed. 0.1 ml of 2 mol $FeCl_2$ solution was added and shaken and kept at dark and room temperature for 70 min. Then, 0.2 ml of 5 mM ferrozin was added and shaken again, and the absorbance of the obtained Fe^{2+}-ferrozin complex after 10 min was measured at 562 nm. One milliliter of water was used instead of sample for the control. The equation is as follows (Yen and Wu 1999):

Chelating activity (%) = [1 - (absorbance of sample / absorbance of control)] x 100

H_2O_2 inhibition effect: The H_2O_2 inhibition effect of spice and plant extracts was determined by spectrophotometer (Ruch et al. 1989). One milliliter (2.6 and 10 mg/ ml) of sample, 3.4 ml of 0.1 M phosphate buffer (pH 7.4) and 0.6 ml of 43 mM H_2O_2 were mixed and after 60 min the absorbance of mixture was measured at 230 nm. Control solutions without H_2O_2 were prepared for each sample concentration. To determine the H_2O_2 concentration that was not involved in the reaction, a linear repression equation was used. Phosphate buffer (3.4 ml) was added to 0.6 ml 10, 15, 25, 43 mM H_2O_2 at 230 nm. Linear equation formulas were obtained by the graphic of Standard curve of absorbance vs. different concentrations of (+)- Catechin

A (230)=0.0125 x C (H_2O_2, mM)+0.0873 (R^2=0.9783)

(+)-Catechin was used as the reference antioxidant. The equation used is as follows:

H_2O_2 inhibition capacity (%) = [1-(H_2O_2 conc. of sample/H_2O_2 conc. of control)] x100

Statistical analyses: Statistical analysis was done using the JAMP. Differences between means were analysed by ANOVA test ($p<0.05$) (Puskulcu and Ikiz 1989). This research was performed by three duplicates with a replicate.

Results and Discussion

The visible aspect of fruit is the most important factor that affects consumer product choice. These parameters include fruit color, shape, uniformity, fruit juice yield and size. Total soluble solid content (TSS), titratable acidity (TA) and pH are physico-chemical parameters that better permit to evaluate the fruit quality perception from consumer. For every fruit cultivar, these parameters were evaluated at maturity (ready to eat) (Table 1).

Table 1. Some physico-chemical properties of nectarine, peach and apricot fruit cultivars

Parameters	**Fruit Cultivar**		
	Nectarine (Flanoba)	**Peach (Francoise)**	**Apricot (Ninfa)**
Fruit weight (g)	110.076	116.781	44.866
Seed weight (g)	7.463	5.361	6.587
Fruit width (mm)	78.285	79.501	60.770
Fruit length (mm)	75.600	79.869	62.371
Fruit length/width	0.991	0.998	1.006
TSS (%)	7.300	9.033	8.800
pH	4.067	4.100	4.333
TA (%)	0.744	0.528	1.016
TSS/TA	9.807	17.121	8.659
Fruit juice yield (%)	66.468	65.765	65.611
Fruit Peel Color			
L	38.514	50.639	52.628
a	30.185	15.556	6.669
b	16.621	20.016	23.927

The values of fruit weight, total soluble solids (TSS), pH and titratable acidity (TA) for Francoise peach were obtained as 116.781 g, 9.033%, 4.100 and 0.528%, respectively. The similar values respectively obtained as 110.076 g, 7.300%, 4.067 and 0.744% for Flanoba nectarine (Table 1). Vaio et al. (2008) re-

searched on some peach and nectarine cultivars and they found that sufficient taste value was (SSC > 9.5 °Brix and FF 30–60 N) and high taste value was (SSC > 10 °Brix and FF 30–50 N). They found that mean flesh firmness (46.9 N for nectarines and 42.9 N for peaches) and titratable acidity (9.3 meq/100 ml both for peaches and nectarines) showed no significant differences between peaches and nectarines. Similarly, we found no significant differences between Francois peach and Flanoba nectarine cultivars. Cheng et al. (1994) investigated on pH, TSS and fruit firmness of May Glo, Flavorcrest, Elegant Lady, O'Henry and Flaming Red peach and nectarine cultivars, and the parameters were 3.6, 9.8%, 55.7 N for May Glo; 3.8, 11.0%, 55.9 N for Flavorcrest; 4.0, 12.2%, 45.9 for Elegant Lady; 4.0, 9.6%, 43.4 for O' Hery and 4.1, 10.2% and 54.5 N for Flaming Red cultivar respectively. In our study, TSS of Francoise and Flanoba were found lower than the above mentioned cultivars. The reason for this results may be due to our cultivars are early-maturing types. The values of fruit length and fruit diameter (width) for Francoise peach were obtained as 79.869 mm and 79.501 mm; for Flanoba cultivars these values were obtained to be 75.600 mm and 78.285 mm respectively. Tarighi et al. (2010) studied on Sunking nectarine cultivar and found that average fruit length, width and thickness were 92.51, 98.48 and 25.64 mm, respectively. Results of Tarighi et al. (2010) were higher than our results. Because of this situation may be our cultivars are early-maturing types too.

The values of fruit weight, TSS, pH and TA respectively obtained as 44.866 g, 8.800%, 4.333 and 1.016% for Ninfa apricot (Table 1). Bianko et al. (2010) found that some apricot cultivars average fruit diameter, weight, juice pH, juice acidity and TSS varied greatly, ranging from 37 to 50 mm, from 32.9 to 77.4 g, from 2.2 to 3.6, from 1.59 to 6.66 g L−1, from 11 to 12.4 °Brix respectively. Paydas et al. (1995) determined that Roxana type have the biggest fruit (54.46 g, 61.06 g in 1995) and Sakıt-6 (19.40 g), Sakıt-2 (19.06 g) types have the highest total soluble solid contents. Guleryuz and Ercisli (1995) reported that the values of average fruit weight, TSS and vitamin C contents for Mahmudun Erigi apricot are 39.49 g, 23.70%, and 21.62 mg/100 ml, respectively. Bellini et al. (2008) determined that the fruit weights of their apricot types were between 55 and 90 g. Dwivedi et al. (2008) specified that the Suka apricot type is one of the most promising apricots since it has 30.9% TSS value. Ruiz et al. (2008) reported that Toni, Estrella, Sublime, Maravilla and Rosa apricot types were requiring low cold, early maturing (10 May-5 June), considerably productive, attractiveness, large (80-95 g), possessing hardness pulps, and enduring to fruit cracks. Nyeki et al. (1997) reported that the apricot types cultivating in Hungary like Cegledi Orias, Naggkörösi Orias, Szegedi Mammut, and Ligeti Orias had the fruit weights between 60 and 100 g and large types called as giant type. Researchers indicated apricot fruit characteristics were various. These differences were related to cultivars.

Table 2. DPPH radical scavenging effects, Fe^{2+} chelating activity (%) and H_2O_2 inhibition activity (%) of fruit extracts

Parameters	Fruit Species			
	Nectarine (Flanoba)	Peach (Francoise)	Apricot (Ninfa)	LSD value
EC_{50}	1.800	2.487	2.679	
AE	0.611 a	0.415 b	0.374 b	**0.127**
Fe Chelating Activity	45.395 a	31.872 b	34.892 b	**8.505**
H_2O_2 Inhibition	46.103 a	34.560 b	36.639 ab	**10.461**

[a]Efficiency coefficient (EC_{50}) (mg sample/mg DPPH): sample amount needed to decrease the DPPH concentration at the beginning by 50%, [b]Antiradical activity (AE): 1 / EC_{50}.

**** Values in all the lines not connected by same letter are significantly different (P<0.05)***

Fruit color is another important parameter of fruit quality, since it has been associated with carotenoid content and antioxidant capacity and primarily because it also plays a critical role in consumer perception of high-quality fruit (Bianco et al. 2010). L (brightness, 100 = white, 0 = black), a (+, red; -, green) and b (+, yellow; -, blue) values obtained from fruit color measurements were determined as 38.514, 30.185, 16.621 for nectarine; 50.639, 15.556, 20.016 for peach; and 52.628, 6.669 and 23.927 for apricot fruits, respectively. Vaio et al. (2008) found that a high variability in the ground color of cultivars analysed. The results showed that nectarines had a higher average lightness (L^* = 55.6 and b^*=35.7) than peaches (L^* = 41.2 and b^* = 22.1). A different trend was found for a^* value. These differences indicate that nectarines were yellow-orange in color, while peaches were red-green. Bianko et al. (2010) researched on 16 apricot cultivars, five early-ripening (Ninfa, Pinkot Copty, Silvercot Versyl, Ouardy and Antonio Errani), nine intermediate ripening (Alba, Bella di Imola, Bulida, Dany, Fracasso, Frenesie, Goldrich, Orange Red Bhart and Palummella) and two late ripening (Mandorlon and Pellecchiella). They found that peel color was relatively similar for most cultivars.

There is convincing epidemiological evidence that the consumption of fruits and vegetables is beneficial to health and contributes to the prevention of degenera-

tive processes, particularly lowering incidence and mortality rate of cancer and cardio- and cerebrovascular diseases (Hertog et al., 1993). The protection that fruits and vegetables provide against these diseases has been attributed to the various antioxidant phytonutrients contained in these foods (Rapisarda et al., 1999). We have undertaken this study to evaluate the antioxidant potential of fruit pulp of Flanoba nectarine, Francoise peach and Ninfa apricot cultivars. The antioxidant activity of these fruit species were assessed by means of DPPH test, Fe^{2+} chelating activity (%) and H_2O_2 inhibition activity (%) and the resulting values were correlated with each one of these classes of antioxidant compounds. All fruit species tested in our study showed an evident antioxidant effect (Table 2).

When this three early maturing stone fruit cultivars fruits were evaluated in point of fruit antioxidant contents, it was observed that nectarine Flanoba fruits had higher values than the others. Peach (2,487 mg sample/mg DPPH) and apricot (2,679 mg sample/mg DPPH) fruits showed higher values concerning with EC_{50}. Nectarine was found the lowest with the value of 1,800 mg sample/mg DPPH. The highest values in point of AE, Fe^{2+} chelating activity and H_2O_2 inhibition were obtained from nectarine fruits (Table 2). Jimenez et al. (2008) compared the inhibition of lipid peroxidation in the presence of raw and processed apricot compared with common food antioxidants and they found that the raw apricot exhibited a higher percentage of inhibition (77.1%) than frozen and canned ones. This value was much higher than our H_2O_2 inhibition result. Scalso et al (2005) showed that genetic background (species and cultivars) played an important role for determining the antioxidant potential of fruits. They determined that the comparison among fruits of the most common cultivated varieties of the five different species considered (strawberries, kiwifruit, apples, apricots, and peaches) showed, as indicated by the TEAC values, the following hierarchy of antioxidant capacities: wild strawberries > cultivated strawberries > kiwifruit > apples = apricots (1.39 µmol TE/g FW) = peaches (1.22 µmol TE/g FW). The obtained values of the researchers were different with our results, and this was probably derived from the differences in the methods used in both studies. Another researcher Yigit et al. (2009) determined that apricot kernels have the high level antioxidant activity. Yigit et al. (2009) studied the DPPH radical scavenging activities of water and methanol extracts from apricot cultivars kernels, the results showed that, at a concentration of 100 µg/mL, the water and methanol extracts of the sweet kernel exhibited 89.9 and 87.7% scavenging activity, respectively. However, at a concentration of 300 µg/mL, the respective activities were 89.9 and 92.2%. They determined that there was no noticeable effect of extract concentration for these extracts. Unlike sweet kernel extracts, there was no detectable activity in the bitter kernel extracts at the concentrations studied (100-300 µg/mL).

As a result, nectarine fruits had the highest total antioxidant activity than other stone fruits. Therefore, in terms of antioxidant activities nectarine fruits are more important.

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