JAEFS

International Journal of Agriculture, Environment and Food Sciences

e-ISSN : 2618-5946 DOI: 10.31015/jaefs.18022 www.jaefs.com

Research Article

Int J Agric Environ Food Sci 2(4):131-134 (2018)

Determination of some chemical characteristics and total antioxidant capacity in apple varieties grown in Posof/Ardahan region

Mehmet Polat[1] **Volkan Okatan**[2,*] **Sultan Filiz Güçlü**[3] **Ayşen Melda Çolak**[4]

[1]Süleyman Demirel University, Faculty of Agriculture, Isparta, Turkey
[2]Uşak University, Sivaslı Vocational High School, Sivaslı/Uşak, Turkey
[3]Süleyman Demirel University, Atabey Vocational High School, Atabey/Isparta, Turkey
[4]Uşak University, Department of Horticulture, Faculty of Agriculture and Natural Sciences, Uşak, Turkey

[*]Corresponding Author: okatan.volkan@gmail.com

Abstract

In this study, total phenolic content, antioxidant capacity, total anthocyanin content and total ascorbic acid content (in flesh+peel) of the 7 apple cultivars grown in Posof/Ardahan were measured. The total phenolic content of the three apple cultivars was higher than other cultivars. "Posofkırmızısı", "Sarı şafran" and "Paşa" apple cultivars had the highest total phenoli ccontents (239.22, 228.81 and 222.71 mg of gallic acid equivalents/100 g offlesh+peels, respectively). Results showed that fresh apple had the highest levels for antioxidant capacity (90.32 and 114.23 µmol of vitamin C equivalents/g of flesh+peel) and total anthocyanin content (30.07 to 71.49 mg/100g), whereas lower levels were found for ascorbic acid in flesh+peels. Results covered a narrow range: 17.18–26.83 mg/100g for ascorbic acid content in flesh+peels weight of apple cultivars. As a result, that these apple cultivars have high total phenolic value and antioxidant capacity in flesh+peels. For this reason, it is suggested for consume with their peels.

Keywords: Apple, Total phenolic, Total antioxidant, Anthocyanin, Ascorbic acid

Received: 08.07.2018 Accepted: 20.09.2018 Published (online): 25.09.2018

Introduction

Apple is a member of the Malus genus of the family of Rosacea. Anatolia is one of the natural spread area of apples informed the 48 species that spread the different gene centers (Europe, the Himalayas, China, Japan, Korea and North America) (Dziubiak 2004; Ercişli 2004; Arabacı and Sevindik 2014). The apple varieties given our research are local apple varieties that propagated with grafting by local people in Posof / Ardahan region. Apple is an important fruit in terms of human health is rich in phenolic compounds and antioxidant substances (Arabacı and Sevindik 2014; Chen and Chen 2013; Vauzouret al. 2010; Williams et al. 2004). Apples are quantitatively the most consumed fruits in several countries in Europe and America. (Claire Kevers at al 2011). Apples are a good source of phenolic compounds because their consumption is widespread, and they are available in the market throughout the year. (Claire Kevers at al 2011, Wolfe et al. 2003, Eberhardt et al. 2000). In a fruit, the amount of phenolic contents can vary according to the growth period, the year of harvest, the geographic location, the storage conditions, and most importantly, genetic variation.(Claire Kevers at al 2011; Jiang et al. 2006; McGhie et al. 2005;Rossle et al. 2010; Wojdylo et al. 2008). The total extractable phenolic content has been ranged from 110 to 357 mg/100 g of fresh apple (Eberhardt et al. 2000; Podsedek et al. 2000; Wolfe et al. 2003).

One of the antioxidant is ascorbic acid, the most abundant in fruits and vegetables. Ascorbic acid in the apple is lower compared with other fruits (Arabacı and Sevindik 2014). Ascorbic acid content is reported as 2-30 mg / 100g, varies according to the cultivars of apple (Fisher 1999; Mapson 1970; Schuphan 1956). The phenolics were higher responsibility than Vitamin C for the antioxidant activity (Wolfe et al. 2003). At the same time, the content of total phenolics or others often do not directly reflect the total antioxidant capacity in fruits (Lee et al. 2003)

The aim of this research was determination of the total phenolics, total anthocyanins ascorbic acid content and total antioxidant activity of local apple varieties in Posof/Ardahan region. The obtained results can be used in the registration process of these local varieties and may be taken into consideration in the selection of parents in breeding programs.

Materials and Methods

Fruit Material

Seven varieties of apples ("Posof kırmızısı", "Sarı şafran", "Paşa", "Kaburgalı", "Uruset", "Sütelması" and "Beyazelma") were obtained from the Posof/Ardahan region. The fruits were collected on the harvest time and used for analysis. For the study apple fruits were not stored. Samples were transported to Isparta in icebox for analysis after harvested and the apples were analyzed directly.

Methods

In experiment, 3 samples were prepared for each cultivar. Total phenolic were detected with Folin-Ciocalteu assay. 10 g flesh+peels were centrifuged at 6000 rpm after homogenized in 40 ml ethanol solution. After, diluted (1/10) 1000 µl folin-ciocalteu and 800 µl Na_2CO_3 solution was

Cite this article as : Polat, M., Okatan, V., Guclu, S.F., Colak, A.M. (2018). Determination of some chemical characteristics and total antioxidant capacity in apple varieties grown in Posof/Ardahan region. Int. J. Agric. Environ. Food Sci., 2(4), 131-134. DOI: 10.31015/jaefs.18022

Available online at : www.jaefs.com

DOI: 10.31015/jaefs.18022

added upon supernatant. After 2 h incubated examples were read at 750 nanometer wavelength in spectrophotometer. Water-ethanol mixture was used as blank. Gallic acid is used as a standard in the calculation (Arabacı and Sevindik 2014)

For total anthocyanin analysis, 10 g flesh+pees were homogenized in methanol solution that 1% HCL included. Samples were filtered with filter paper after a night standing. Supernatant were incubated in tampon solution (pH 1.0 and pH 4.5). Samples were read against the blank at 530 and 700 nanometer wavelengths. Results were calculated using siyanidin- 3-galactoside molar absorbtivit coefficient (Arabacı and Sevindik 2014)

For ascorbic acid analysis, fruit juice samples were obtained by pureed and filtered. Samples were homogenized by centrifuge. 400 µLokzalic acid (0.4% 0.4) and 4.5 ml 2,6-diklorofenolindofenol solution were added upon supernatant. Data were read against the blank at 520 nanometer wavelengthin spectrophotometer (Arabacı and Sevindik 2014).

Antioxidant capacity was determined using DPPH method. Fruit juice samples were obtained by pureed and filtered. Samples were homogenized by centrifuge. 950 µl 0.1 N DPPH (1,1-diphenyl-2-picrylhydrazyl) solution was added upon 50 µl supernatant. Then it was read against the blank at 515 nm wavelength spectrophotometer (Suils et al. 2000, Bakhshiand Arakawa 2006; Rezaeiradet al. 2013, Arabacı and Sevindik 2014).

Statistical Analysis

In this research, Data were checked for normal distribution that is the precondition of parametric tests. Normal distribution and homogeneity of variance were checked by Anderson-Darling test and Bartlett's Chi-square test respectively. The difference between the average rank of the varieties were analyzed with the Kruskal-Wallis test due to abnormal distribution. Differences between varieties were analyzed by Bonferroni-Dunn multiple comparison test. Statistical analyzes were performed using Minitab 16 software package.

Results and Discussion

In this research, the total phenolic, anthocyanin and ascorbic acid contents and antioxidant activity of the flesh+peel of the seven apple varieties were determined (Table 1). The Kruskal-Wallis test was applied to data. The differences between the average rank of the varieties are statistically significant ($p<0.01$). The Bonferroni-Dunn test was applied to differences between the average ranks of the varieties and shown in Table 1. The phenolic content was found to vary from 126.42 to 239.22 mg/100 g according to the variety.

The total phenolic contents of "Posofkırmızısı" and "Sarı şafran" varieties were highest at 239.22and 228.81 mg of gallic acid equivalents/100 grespectively (Table 1, Figure 1). These values were significantly different. Other cultivarswere followed by 222.71 mg/100g for"Paşa", 190.56mg/100g for "Kaburgalı", 155.66 mg/100g for "Uruset", 140.20 mg/100g for "Sütelması" and 126.42 mg/100g for "Beyazelma"cultivars(Table 1, Figure 1). The total phenolic contents of the "Beyazelma" were significantly lowest than the other all varieties. Different researchers were informed the results for total phenolic in apple. Our data was similar this results (Vrhovseket al.16; 66-212 mg/100 g, Kevers et al. 2011; 140 to 447 mg/100 g, Wolfe et al. 2003; 159to119.0 mg/100g, Arabacı and Sevindik 2014; 46.9 to 112.2 mg/100g).

Total anthocyanin contents of "Kaburgalı" were highest at 71.50 mg/100g, followed by "Beyazelma" and "Uruset" varieties (63.21 mg/100g and 58.28 mg/100grespectively) (Table 1, Figure 2). These value differences between "Kaburgalı" were significant. "Sarı şafran", "Paşa" and "Posofkırmızısı" varieties were followed by others (34.56 mg/100g, 33.32 mg/100g and 32.44 mg/100g respectively) (Table 1, Figure 2). The differences between these three varieties were significant. Different researchers were found results that wide ranged. Arabacı and Sevindik 2014 were informed from 0.5 to 49.1 mg/100g for total anthocyanin amount of apple peels but, only one apple variety has anthocyanin (35.9 mg/100g for red colored flesh Uruset). Wolfe at al. (2003)was reported from 2.1 to 26.8 mg of cyanidin 3-glucoside equivalents/100 g of peels. Rababah et al. (2005) was determinedas 9.2 mg/kgof apple. Our data was similar this results. According to some researchers, the amount of anthocyanin is varies according to peel color of fruits. And this depends on the presence of cyanidin 3-galactoside that makes the peel red color (Wolfe at al. (2003); Awad and Jager 2000).

Table 1. Total phenolic and anthocyanin, ascorbic acid and free radical activity of apple cultivars

Variable	Total Phenolic (mg of gallic acid equivalents/100 g)		Total Anthocyanin (mg/100g)		Antiokcidant Activity (µmol of vitamin C equivalents/g)		Ascorbic Acid (mg/100g)	
Variety	Mean	Rank means	Mean	Rank means	Mean	Rank means	Mean	Rank means
Kaburgalı	190,56±0,12	11 D	71,50±0,18	20A	90,32±0,00	2 G	17,18±0,13	2 F
Posofkırmızısı	239,22±0,10	20 A	32,44±0,10	5F	114,23±0,01	20 A	19,93±0,07	12,3 C
Uruset	155,66±0,12	8 E	58,28±0,15	14 C	110,72±0,01	17 B	17,69±0,14	5 E
Paşa	222,71±0,21	14 C	33,32±0,05	8E	104,41±0,03	5 F	19,77±0,04	8 D
Sütelması	140,20±0,26	5 F	30,07±0,09	2G	106,32±0,04	8 E	19,88±0,01	12,7 C
Beyazelma	126,42±0,03	2 G	63,21±0,05	17B	107,80±0,03	11 D	26,83±0,11	20 A
Sarı şafran	228,81±0,08	17 B	34,56±0,03	11 D	109,68±0,00	14 C	24,40±0,03	17 B

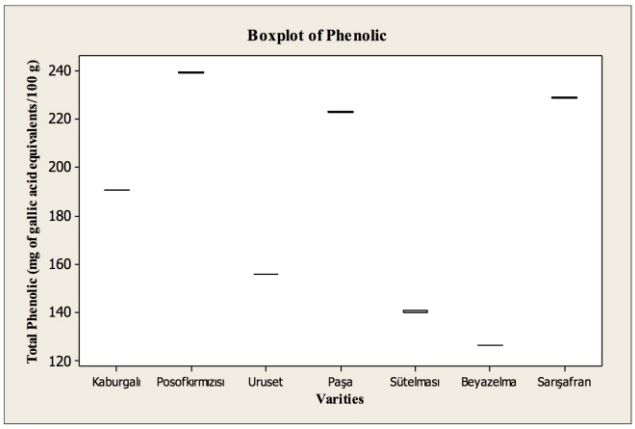

Figure 1. Boxplot of Phenolic (Means and SE Mean)

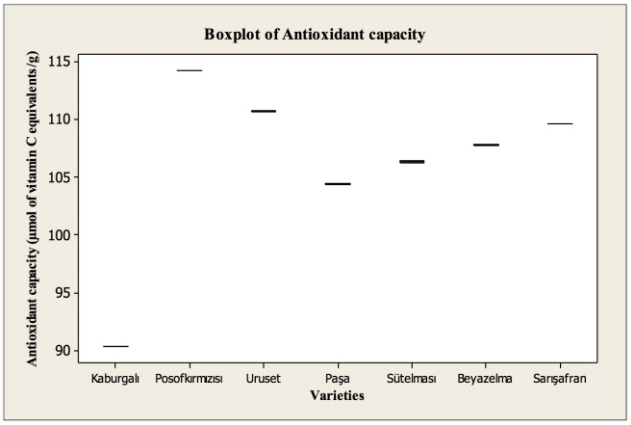

Figure 3. Boxplot of Antioxidant capacity(Means and SE Mean)

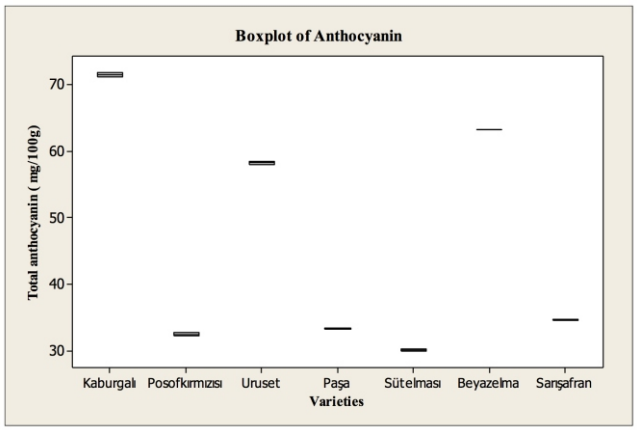

Figure 2. Boxplot of Anthocyanin (Means and SE Mean)

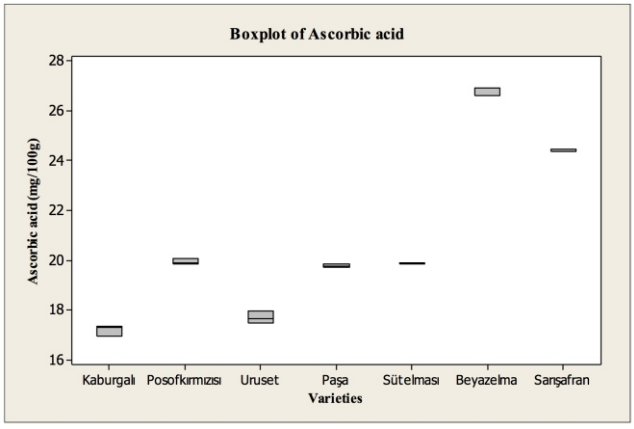

Figure 4. Boxplot of Ascorbic acid (Means and SE Mean)

In this research, ascorbic acid contents of apple varieties were shown in Table 1 and Figure 3. "Beyezelma" and "Sarı şafran" varieties were highest amount of ascorbic acid (26.83mg/100g and 24.40 mg/100g respectively). These values were significantly different. Other cultivars were followed by 19.93 mg/100g for "Posofkırmızısı", 19.88 mg/100g for "Sütelması", 19.77mg/100g for "Paşa", 17.69 mg/100g for "Uruset" and 17.18mg/100g for "Kaburgalı" (Table 1, Figure 3). The differences between these four varieties were significant and significant differences are between these four varieties and the varieties which has the highest value ("Beyezelma" and "Sarı şafran"). Different researchers were informed the results for total phenolic in apple. Our data was similar this results (Szeto et al. 2002; 60 mg/100g, Arabacı and Sevindik 2014; 5.2 to 17.2 mg/100g, Kevers et al. 2011; 11.6 to 35.3 mg/100g, Gardner et al. 2000; 3.9 mikroM, Lee et al. 2003; 9.0 to 16.6 mg/100g, Miller et al 1997; 51 µmol/litreof juice). At the same time, our data were higher than many other researchers reported. The reason for this is believed to be genetic variations and effects of growth area conditions.

The antioxidant activity of "Posofkırmızısı" was highest at 114. µmol of vitamin C equivalents/g, followed by "Uruset", "Sarı şafran", "Beyazelma", "Sütelası" and "Paşa" varieties (110.72, 109.68, 107.80, 106.32 and 104.41 µmol of vitamin C equivalents/g respectively) (Table 1, Figure 4). These values were significantly different. The antioxidant activity of the "Kaburgalı" (90.32 µmol of vitamin C equivalents/g) were significantly lowest than the other all varieties. Different researchers were informed the results for total phenolic in apple. Our data was similar this results (Szeto et al. 2002; 6300 4200 µmol/kg fresh wet wt, Arabacı and Sevindik 2014; 21.7-57.8%, Kevers et al. 2011; 1101-4917 µmolTE/100 g FW, Van der Sluis et al. 2001; IC50: 5.8-8.0 g of fw/L, Lee et al. 2003; 116.22 mg of VCEAC/100 g, Rababah et al. 2005; 17.7 mM TE/kg).

Conclusion

As a result, that these local apple cultivars have high total phenolic, anthocyanin and antioxidant capacity in flesh+peels. It is known, positive effect on human health of these substances. For this reason it is suggested for consume with their peels.

DOI: 10.31015/jaefs.18022

References

Arabacı Z.T. and Sevindik E. (2014). Determination of Bioactive Compounds and Total Antioxidant Capacity in Apple Varieties Grown in Ardahan Region. Yuzuncu Yil University Journal of Agricultural Sciences (YYU J AGR SCI), 24(2): 175- 184

Awad, M.A., de Jager, A. (2000). Flavonoids and chlorogenic acid concentrations in skin of 'Jonagold' and 'Elstar' apples during and after regular and ultra low oxygen storage. Postharvest Biol. Technol., 20(1), 15-24

Bakhshi, D., Arakawa, O. (2006). Effects of UV-b irradiation on phenolic compound accumulation and antioxidant activity in 'Jonathan' apple influenced by bagging, temperature and maturation. Journal of Food, Agriculture & Environment. 4 (1): 75-79.

Chen, A.Y., Chen, Y.C. (2013). A review of the dietary flavonoid, kaempferol on human health and cancer chemoprevention. Food Chemistry. 138 (4): 2099-2107.

Dziubiak, M. (2004). Collection of the genus Malus Mill. In the botanical garden of the polish Academy of sciences in Warsaw. Journal of fruit and ornamental plant research, 12: 121-128.

Eberhardt, M.V., Lee, C.Y., Liu, R.H. (2000). Antioxidant activity of fresh apples. Nature 405, 903-904.

Ercişli, S. (2004). A short review of the fruit germplasm resources of Turkey. Genetic Resources and Crop Evolution. 51: 419-435

Fisher, C. (1999). Ergebnisse der ApfleZüchtung in Dresden-Pillnitz. Berlin. Erwerbsobstbau. 41: 65-74.

Gardner, P.T., White, T.A.C, McPhail, D.B. and Duthie, G.G. (2000). The relative contributions of vitamin C, carotenoids and phenolics to the antioxidant potential of fruit juices. Food Chemistry (68) 471-474

Jiang, H., Ji, B.P., Liang, J.F., Zhou, F., Yang, Z.W., Zhang, G.Z. (2006). Changes of contents and antioxidant activities of polyphenols during fruit development of four apple cultivars. Eur. Food Res. Technol. 223, 743–748.

Kevers, C., Pincemail, J., Tabart, J., Defraigne, J.O., Dommes, J. (2011). Influence of Cultivar, Harvest Time, Storage Conditions, and Peeling on the Antioxidant Capacity and Phenolic and Ascorbic Acid Contents of Apples and Pears. Agric. Food Chem., 59, 6165–6171.

Lee, K.W., Kim, Y.J., Kim, D., Lee, H.J., Lee, C.J. (2003). Major Phenolics in Apple and Their Contribution to the Total Antioxidant Capacity. J. Agric. Food Chem., 51, 6516-6520

Mapson, L.W. (1970). Vitamins in fruits. In: Hulme, A.C. (Ed.s), The Biochemistry of Fruits and Their Products, Vol. 1. pp. 369-383. Academic Press, London.

McGhie, T. K., Hunt, M., Barnett, L.E. (2005). Cultivar and growing region determine the antioxidant polyphenolic concentration and composition of apples grown in New Zealand. J. Agric. Food Chem., 53, 3065–3070.

Miller, N.J. and Rice-Evans C.A. (1997). The relative contributions of ascorbic acid and phenolic antioxidants to the total antioxidant activity of orange and apple fruit juices and blackcurrant drink. Food Chemistry, Vol. 60, No. 3, pp. 331-337

Podsedek, A., Wilska-Jeska, J., Anders, B., Markowski, J. (2000). Compositional characterization of some apple varieties. Eur. Food Res. Technol., 210, 268-272.

Rababah, T.M., Ereıfej, K.I. and Howard, L. (2005). Effect of Ascorbic Acid and Dehydration on Concentrations of Total Phenolics, Antioxidant Capacity, Anthocyanins, and Color in Fruits. J. Agric. Food Chem., 53, 4444-4447

Rossle, C., Wijngaard, H.H., Gormley, R.T., Butler, F., Brunton, N. (2010). Effect of storage on the content of polyphenols of minimally processed skin-on apple wedges from ten cultivars and two growing seasons. J. Agric. Food Chem. 58, 1609–1614.

Schuphan, W. (1956). Valeur nutritive des fruits en rapport avec l'alimentationhumaine. In: Soc. Pomol. France. C.R. Congr. Pomol.Int., 87e Sess. Namur, Belgium.

Szeto, Y.T., Tomlinson, B. and Benzie I.F.F. (2002). Total antioxidant and ascorbic acid content of fresh fruits and vegetables: implications for dietary planning and food preservation. British Journal of Nutrition (2002), 87, 55–59

Van der Sluis, A.A., Dekker, M., Jager A. and Jongen, W.M.F. (2001). Activity and Concentration of Polyphenolic Antioxidants in Apple: Effect of Cultivar, Harvest Year, and Storage Conditions. J. Agric. Food Chem., 49, 3606-3613

Vauzour, D., Rodriguez-Mateos, A., Corona G., Oruna-Concha, M.J., Spencer, J.P.E. (2010). Polyphenols and human health: Prevention of Disease and Mechanisms of Action. Nutrients. 2: 1106-1131.

Williams, R.J., Spencer, J.P., Rice-Evans, C. (2004). Flavonoids: antioxidants or signalling molecules? Free Radic. Biol. Med. 36: 838-849

Wojdylo, A., Oszmianski, J., Laskowski, P. (2008). Polyphenolic compounds and antioxidant activity of new and old apple varieties. J. Agric. Food Chem. 56, 6520–6530.

Wolfe, K., Wu, X. and Liu R.H. (2003). Antioxidant Activity of Apple Peels. J. Agric. Food. Chem., 51, 609-614