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Full Length Research Paper

Antioxidant properties of 12 cornelian cherry fruit types (*Cornus mas* L.) selected from Turkey

Nilda Ersoy[1]*, Yavuz Bagci[2] and Veli Gok[3]

[1]Department of Horticultural Science, Faculty of Agricultural, Selcuk University, Konya, Turkey.
[2]Department of Biology, Faculty of Science and Education, Selcuk University, Konya, Turkey.
[3]Department of Food Engineering, Faculty of Engineering, Afyon Kocatepe University, Afyonkarahisar, Turkey.

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***Cornus mas* L. is a naturally growing dogwood species in Anatolia. In present study, the antioxidant activity of 50% aqueous methanol extracts of 12 cornelian cherry types were evaluated by various antioxidant assay, including free radical scavenging, hydrogen peroxide (H_2O_2) scavenging and metal (Fe^{+2}) chelating activities. The methanolic fruit etxracts of the *Cornus mas* L. fruit types (H_2O_2 and diphenylpicrylhydrazyl (DPPH) scavenging activities, Fe^{+2} chelating activity) examined in the assay showed the strongest activities. The highest antiradical activity was found 44-05 type (0.943) followed by 44-04 (0.860), 77-09 (0.810) and 77-05 (0.723) types respectively. The lowest value was found 44-01 (0.537), 77-06 (0.580), 77-11 (0.567) and 77-02 (0.563) types. The highest chelating activity was found; 44-05 (54.213%), 44-04 (49.890%), 77-09 (47.287%) and 77-05 (45.180%) cornelian cherry type respectively. The lowest cheting activity was found 77-06 (33.883%), 44-01 (34.106%) and 77-11 (34.510%) types. In terms of H_2O_2 inhibition, the highest rate was obtained from 44-05 (79.103%), the lowest one was 44-01 type to be 37.720%.**

Key words: Cornelian cherry (*Cornus mas* L.), antioxidant properties, fruit.

INTRODUCTION

Food-based fruit and vegetables probably reduces the lower risk of heart disease and some neurological diseases and there is evidence that some types of vegetables and fruits in general, protect against some cancer types. Since fruits and vegetables happen to be good sources of antioxidants, this suggested that antioxidants might prevent some types of diseases (Stanner et al., 2004).

Cornelian cherry (*Cornus mas* L.) belongs to the family *Cornaceae* (Rop et al., 2010). It is a wild plant that grows in Asia and Europe, as well as being recently cultivated in Turkey (Kalyoncu et al., 2009, Gulcin et al., 2005). Turkey is an important producer of cornelian cherries (*Cornus mas* L.), especially in northern Anatolia (Yaltirik, 1981; Ercisli et al., 2007). In Turkey, approximately 12,800 tons of cornelian cherry fruit is produced per annum (Kalyoncu et al., 2009; Celik et al., 2006). This species grows in the temperate zone of Eurasia on calcareous, well-drained forest soils. It ranges from a shrub to a small tree of about 7-8 m in height and can be cultivated under the shade of tall trees (Ercisli et al., 2007; Yaltirik, 1981). The species is highly tolerant to diverse abiotic and biotic conditions. The fruits are very valuable for fresh consumption and for processing to produce syrups, juices, jams, spirits and other traditional products (Rop et al., 2010).

Recently, some studies have been published about antioxidant activity of cornelian cherry fruits (Hashempour et al., 2010, Rop et al. 2010, Yilmaz et al. 2009, Tural and Koca, 2008, Pantelidis et al., 2007; Gulcin et al., 2005). On the other hand, the bioactive content of fruits varies from genotype to genotype (Ercisli and Orhan, 2007). Therefore, attention has more recently been focused on assessing the distribution on biologically active com-pounds among different cultivars/genotypes (Pantelidis et al., 2007). In the present study, the antioxidant activity of 12 cornelian cherry types was examined in the different antioxidant assays including

*Corresponding author. E-mail: nersoy@selcuk.edu.tr

free radical scavenging activity, metal (Fe^{+2}) chelating activities (%) and inhibition activity of hydrogen peroxide (H_2O_2).

MATERIALS AND METHODS

Materials

Materials were obtained from cornelian cherry garden of Ataturk Horticultural Research Institute-Yalova, Turkey. Cornelian cherry garden is eight years old and samples consist of from 12 cornelian cherry types from East Anatolia (Malatya) (44-01, 44-04, 44-05, 44-07) and South Marmara (Yalova) (77-01, 77-02, 77-03, 77-05, 77-09, 77-10, 77-11, 77-12) region bring by selection. Materials were brought in PVC containers. Samples were kept in sealed containers at -18°C during the study.

Preparation of extracts

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).

Methods

Free radical scavenging effect

The radical scavenging activity against the diphenylpicrylhydrazyl (DPPH) 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^{-1} 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^{-1} were prepared with methanol. Then 3.9 ml DPPH solution prepared with 6 x 10^{-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^{-1}). All analyses were carried out in duplicate.

Linear regression equations of absorbance against concentrations were determined by measuring the absorbances of seven different concentrations of DPPH (6 x 10^{-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^{-1} 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 millilitre 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 millilitre (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 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

Free radical scavenging activity

DPPH, as a partially organic radical, is used to determine the antioxidant activities of many plant extracts and compounds (Brand-Williams et al., 1995). This method is based on a decrease in alcoholic DPPH solution in the presence of H binding antioxidant b (DPPH + AH→DPPH – H + A). A DPPH solution is dark violet colored and has a strong absorption range at 517 nm. It loses its color when transformed to DPPH-H and the absorption level decreases. This decrease in absorption shows the cytochiometric decrease in DPPH (Serteser et al., 2008, 2009a, b). The DPPH radical scavenging effects of cornelian cherry fruit extracts are given in Table 1. The DPPH radical scavenging assay is commonly employed to evaluate the ability of antioxidant to scavenge free radicals. The use of the DPPH free radical is advantageous in evaluating antioxidant effectiveness because it is more stable than the hydroxyl and super oxide radicals (Layina-Pathirana et al., 2006). Radical

Table 1. DPPH radical scavenging effects of fruit extracts*

Cornelian cherry type	EC_{50}	AE
44-05	1.060	0.943 a
44-04	1.163	0.860 b
77-09	1.240	0.810 c
77-05	1.380	0.723 d
44-07	1.450	0.690 e
77-01	1.513	0.660 f
77-12	1.540	0.657 fg
77-10	1.583	0.633 g
77-06	1.730	0.580 h
77-11	1.770	0.567 h
77-02	1.780	0.563 h
44-01	1.863	0.537 ı
LSD value	-	0.046

[a]Efficiency coefficient (EC_{50}) (mg sample/ mg DPPH): sample amount needed to decrease the DPPH concentration at the beginning by 50%, [b]Antiradical activitiy (AE): 1 / EC_{50}. Levels not connected by same letter are significantly different ($p<0.05$).

Table 2. Fe^{+2} chelating activity (%) of fruit extracts.

Cornelian cherry type	Chelating activity (%)
44-05	54.213 a
44-04	49.890 b
77-09	47.287 c
77-05	45.180 d
44-07	41.440 e
77-01	41.180 e
77-12	39.983 f
77-02	36.246 g
77-10	36.233 g
77-11	34.510 h
44-01	34.106 h
77-06	33.883 h
LSD value	2.071

Levels not connected by same letter are significantly different ($p<0.05$).

scavenging activity, expressed as EC_{50}, ranged from 1.060 to 1.863 mg ml^{-1}.The inverse relationship was found between antiradical activity and EC_{50} values in the cornelian cherry fruit types. Because of a lower EC_{50} value indicates greater antioxidant activity. Among 12 cornelian cherry types have different results. According to Table 1, the highest antiradical activity was found 44-05 type (0.943) followed by 44-04 (0.860), 77-09 (0.810) and 77-05 (0.723) types respectively. The lowest value was found 44-01 (10.537), 77-06 (0.580), 77-11 (0.567) and 77-02 (0.563) types and these values were in the same group to be statistically and these were the second lowest group. Although, grown under the same conditions, statistically significant differences were observed among types in terms of antiradical activity. The reason for this is the bioactive content of fruits varies from genotype to genotype (Ercisli and Orhan, 2007). Tural and Koca (2008) obtained that EC_{50} values were in the range of 0.29-0.69 mg.ml-1.24 in different natural cornelian cherry types in their work.

Serteser et al. (2008) researched on some medicinal and aromatic plants obtained from several locations of the Afyonkarahisar province in Turkey and they found that cornelian cherry fruit had the highest antiradical activity (0.928) among their experimental plants. The same researchers found that the highest DPPH radical scavenging effects were in the fruit extracts of *Cornus* and *Morus* species with values which varied from 1.078-1.212 (EC_{50}). Tural and Koca (2008) reported that the methanolic extracts of the Cornelian cherry (*Cornus mas* L.) fruits showed EC_{50} (mg ml^{-1}) (DPPH reduction) values as 0.52. EC_{50} values were lower than the results of Tural and Koca (2008). Dragovic-Uzelac et al. (2007) determined that DPPH values in two different cornelian cherry types were between 33.41 and 39.89 mmol Trolex equvalent/kg f.w. among some fruit species in their work. Paulovicsova et al. (2009), found that the antiradical activities were 77.59- 84.56 and 88.85% in three cornelian cherry types. However, these contradictory results are most likely due to differences in methodology and experimental conditions used in the different studies. Due to the wide wariety of potential antioxidant compounds, such as vitamins, flavonoids, phenolic acids and sulphur compounds present in plants, differences in the method of sample extraction can results in a wide variation in the antioxidant activity of the extract (Nuutila et al., 2003). The DPPH method is based on reduction of stable DPPH nitrogen radicals in presence of antioxidants (Huang et al., 2005). Moreover, even for values obtained from the same assay, a comparison with the data in the literature was problematic due to the large variability within the food item and to the lack of standardization of the assays.

Fe^{+2} chelating activity

Chelating agents may have great importance for rancidity of oily foods; even though they are not antioxidant materials. Because iron catalyzes this reaction during lipid peroxidation, Ferrozin forms a complex with Fe^{+2}. The amounts of complex and red color decrease in the presence of the other chelating agents. A decrease in absorption values can be determined by changes in the color. The decrease in absorption shows the effectiveness of chelating agent added with the exception of ferrozin (Serteser et al., 2008, 2009a, b). Table 2 shows the chelating activities of cornelian cherry types fruit extracts.

According to the Table 2, the highest chelating activity

Table 3. H_2O_2 inhibition activity of fruit extracts.

Cornelian cherry type	Inhibition (%)
44-05	79.103 a
44-04	60.753 b
77-09	58.117 c
77-05	54.710 d
44-07	50.743 e
77-12	49.067 f
77-01	49.013 f
77-02	43.943 g
77-10	42.863 g
77-11	41.320 h
77-06	39.870 ı
44-01	37.720 j
LSD value	2.228

Levels not connected by same letter are significantly different ($p < 0.05$).

was found; 44-05 (54.213%), 44-04 (49.890%), 77-09 (47.287%) and 77-05 (45.180%) cornelian cherry type respectively. These four values were statistically different groups. The lowest chelating activity was found 77-11 (33.883%), 44-01 (34.106%) and 77-11 (34.510%) type and these values were statistically the same group. The other types of values has taken place among these values.

Serteser et al. (2009a) reported that the highest chelating activity was found in *Cornus mas* fruit extracts. The chelating activities of *Cornus* spp. Fruit extracts were found higher compared with other fruit extracts. The highest chelating activity was observed in the *Cornus* species ranging from 44.64-45.72%. Pantelidis et al. (2007) found that *Cornus mas* cv. Vermio cultivar had 83.9 µmol g^{-1} dw Ferric Reducing Antioxidant Power (FRAP) value. Chelating agents may have a great importance for rancidity of oily foods, even if they are not antioxidant materials. Because iron catalyzes this reaction during lipid peroxidation (Yen and Duh, 1994). The FRAP assays evaluate the chain-breaking antioxidant potential (Ghiselli et al., 1995) and the reducing power of the sample (Benzie and Strain, 1996), respectively.

FRAP assay works employing metals ions for oxidation, measuring the formed ferrous ions by increased absorbance, instead of the use of organic radical producers (Schlesier et al., 2002). The same authors strongly suggested the application of at least two methods for determination of antioxidant activity, due to differences between the test systems.

H_2O_2 ınhibition activity

This method is used to eliminate $O_2\bullet^-$, even though the superoxide radical anion ($O_2\bullet^-$) does not initiate lipid oxidation directly. Super reactive hydroxyl radical (.OH) may be formed from the Fenton Reaction ($Fe^{+2} + H_2O_2 \rightarrow Fe^{+3} + OH^- + .OH$) in the presence of metal ions. For this reason, H_2O_2 inhibition activity is an important method for the determination of antioxidant characteristics (Serteser et al., 2008, 2009a, b). The H_2O_2 inhibition activities of cornelian cherry fruit extracts are given in Table 3.

Cornelian cherry types have different rates in terms of H2O2 inhibition. The highest rates were found in 44-05 (79.103%), 44-04 (60.753%), 77-09 (58.117%) and 77-05(54.710%) types as well as in the other two methods. In addition, they were obtained from the type that was between these values and as such, they were statistically different. The lowest value was found 44-01 type to be 73.720%. Serteser et al. (2009a) reported that, *Cornus* species showed the highest H_2O_2 inhibition values (54.32-65.42%) in their research. The H_2O_2 inhibition value found from 44-05 type in our research was higher than cornus types which were in Serteser et al. (2009a) research.

In conclution, the information obtained in this article might be useful for the devolepment of food products and appropriate addivitives with antioxidant properties. Having the highest antioxidant content types have been 44-05, 44-04, 77-09 and 77-05 respectively. Therefore, these types are primarily offered as a source of antioxidants.

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REFERENCES

Benzie IFF, Strain JJ (1996). The ferric reducing ability of Plasma (FRAP) as a measure of "Antioxidant Power": The FRAP assay. Anal. Biochem., 239: 70-76.

Brand-Williams W, Cuvelier ME, Berset C (1995). Use of a free radical method to evaluate antioxidant activity. LWT-Food Sci. Technol., 28: 25-30.

Celik S, Bakirci I, Sat IG (2006). Physicochemical and organoleptic properties of yogurt with cornelian cherry paste. Int. J. Food Property, pp. 401-408.

Dragovic-Uzelac V, Levaj B, Bursać D, Pedisić S, Radojčić I, Biško A (2007). Total Phenolics and Antioxidant Capacity Assays of Selected Fruits,Agriculturae Conspectus Scientific us, 72(4): 279-284.

Ercisli S, Orhan E, Eşitken A, Yıldırım N, Ağar G (2007). Relationships among some cornelian cherry genotypes (*Cornus mas* L.) based on RAPD analysis. Genetic Resources and Crop Evolution, 55(4): 613-618

Ercisli S, Orhan E (2007). Chemical composition of white (*Morus alba*), red (*Morus rubra*) and black (*Morus nigra*) mulberry fruits. Food Chem., 103: 1380-1384.

Ghiselli A, Serafini M, Maiani G, Azzini E, Ferro-Luzzi A (1995). A fluorescence-based method for measuring total plasma antioxidant capability. Free Radic. Biol. Med., 18: 29-36.

Gulcin I, Beydemir S, Sat IG, Küfrevioğlu OI (2005). Evaluation of antioxidant activity of cornelian cherry (*Cornus mas* L.). Acta Alimentaria, 34(2): 193.202.

Hashempour A, Ghazvini RF, Bakhshi D, Ghasemnezhad M, Sharafti M, Ahmadian H (2010). Ascorbic Acid, Anthocyanins, and Phenolics

Contents and Antioxidant Activity of Ber, Azarole, Raspberry, and Cornelian Cherry Fruit Genotypes Growing in Iran. Horticult. Environ. Biotechnol., 51(2): 83-88.
Huang D, Ou B, Prior RL (2005). The chemistry behind antioxidant capacity assays-Reviews. J. Agric. Food Chem., 53: 1841-1856.
Kalyoncu IH, Ersoy N, Yilmaz M (2009). Physico-chemical and Nutritional properties of Cornelian Cherry Fruits (*Cornus mas* L.) Grown in Turkey. Asian J. Chem., 21(8): 6555-6561.
Layina-Pathirana CM, Shahidi F, Alasalvar C (2006). Antioxidant activity ofcherry laurel fruit (Laurocerasus officinalis Roem.) and its concentrated juice. Food Chem., 99: 121-128.
Lim YT, Murtijaya J (2007). Antioxidant properties of Phyllanthus amarus extracts as affected by different drying methods. Lebensmittel Wissenschaft und Technologies, 40: 1664-1669.
Nuutila AM, Puupponen-Pimia R, Aarni M, Oksman CKM (2003). Comparison of antioxidant activities of onion and garlic extracts by inhibition oflipid peroxidation and radical scavenging activity. Food Chem., 81: 485-493.
Pantelidis GE, Vasilakakis M, Manganaris GA, Diamantidis G (2007). Antioxidant capacity, phenol, anthocyanin and ascorbic acid contents in raspberries, blackberries, red currants, gooseberries and cornelian cherries. Food Chem., 102: 777-783.
Paulovicsova B, Aulovicsová B, Turianica I, Juríková T, Baloghová M (2009). Anim. Breeding Biotechnol., 42(1): 608-614, Timişoara.
Puskulcu H, İkiz F (1989). Introduction to Statistic. Bilgehan Press, p.333, Bornova, Izmir, Turkey.
Rop O, Mlcek J, Kramarova D, Jurikova T (2010). Selected cultivars of cornelian cherry (*Cornus mas* L.) as a new food source for human nutrition. Afr. J. Biotechnol., 9(8): 1205-1210.
Ruch RJ, Cheng SJ, Klaunig JE (1989). Prevention of cytotoxicity and inhibition of intracellular communication by antioxidant catechins isolated from Chinese green tea. Carcinogenesis, 10: 1003-1008.
Schlesier K, Harwat M, Bohm V, Bitsch R (2002). Assessment of antioxidant activity by using different *in vitro* methods. Free Radical Res., 36: 177-187.
Serteser A, Kargıoglu M, Gok V, Bagcı Y, Özcan MM, Arslan D (2008). Determination of antioxidant effects of some plant species wild growing in Turkey. Int. J. Food Sci. Nutr., pp. 1-9.
Serteser A, Kargioglu M, Gok V, Bagci Y, Özcan MM, Arslan D (2009a). Antioxidant properties of some plants growing wild in Turkey. GRASAS Y ACEITES, 60(2): 147-154.
Serteser A, Kargıoglu M, Gok V, Bagci Y, Özcan MM (2009b). Antioxidant Activity of *Ribes multiflorum* Kit.ex Roem. and Schult (blackcurrant) Extract. Jeobp, 12(5): 635-639.
Stanner SA, Hughes J, Kelly CN, Buttriss J (2004). A review of the epidemiological evidence for the 'antioxidant hypothesis. Public Health Nutr., 7(3): 407-222.
Tural S, Koca I (2008). Physico-chemical and antioxidant properties of cornelian cherry fruits (*Cornus mas* L.) grown in Turkey. Scientia Horticulturae, 116: 362-366.
Yaltirik F (1981). Dendrology I: Istanbul: Istanbul University Forestry Faculty Press, 229: 72-73.
Yen GC, Duh PD (1994). Scavenging effect of methanolic extracts of peanut hulls on free-radical and active oxygen species, J. Agric. Food Chem., 42: 629-632.
Yen GC, Wu JY (1999). Antioxidant and radical scavenging properties of extracts from *Ganoderma tsugae*. Food Chem., 65: 375-379.
Yilmaz KU, Ercisli S, Zengin Y, Sengul M, Yasa KE (2009). Preliminary characterisation of cornelian cherry (*Cornus mas* L.) genotypes for their physico-chemical properties. Food Chem., 114(2): 408-412.