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Antioxidant Activity and Phenolic Contents of 30 Selected Medicinal Plants

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Abstract

Plant aerial parts were tested for their free radical scavenging action by their interaction with 1,1-diphenyl-2-picrylhydrazyl (DPPH) and total phenol. The results showed that the total phenolics varied significantly and ranged from 0.411 mg GAE/100 ml to 3.337 mg GAE/100 ml. The highest phenolic contents was determined in *Aethionenmu devmonii*. Antioxidant activity of plant extracts by the DPPH scavenger method (inhibition %) were found between 45.074% (*Silene lephackola*) to 81.527% (*C.babylonica* L.). It was concluded that the methanolic extracts of these widely consumed spices in Turkey are good sources of phenolic materials and have high antioxidative and free radical scavenging activities.

Keywords: medicinal plant, extract, antioxidant activity, total phenol, DPPH

1. Introduction

The antioxidant action of herbs used in Turkey for treating various ailments was evaluated *in vitro*. Fruits, vegetables and herbs are recommended at present as optimal sources of chemical constituents with antioxidant activity and supplementation of human diet with plants containing high amounts of compounds capable of deactivating free radicals may have beneficial effects [9, 10, 16, 17]. Recently, the use of spices and herbs as antioxidants agents in foods is becoming of increasing importance. Phenolic compounds in plants provide an array of natural sources of antioxidants for use in foods and nutraceuticals.

Since natural sources contain a variety of phenolic compounds with varying antioxidant activity and exert their effects via different mechanisms, their efficacy in bulk oils, emulsions and composite foods might be greater than that of individual compounds [14]. It is difficult to see the accordance of the results in literature on antioxidant activity because of the usage of the different testing methods. Frankel et al. (1996) [5] reported that there are a lot of literature on the activity of natural antioxidants and stability evaluations of different unsaturated food lipids.). Chen et al. (1999) [3] reported that some flavonids from plant has very high inhibition effect on meat oil, fish oil and lard.

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And also they reported that flavonoids can reduce the absorbtion of the carsinogenic substances in colon.

There are limited studies on antioxidant activity and the phenolic contentss of these plants. They also expressed that the phenolic content and the antioxidant activity of the *O. vulgare* L. extracts were in accordance with Deighton et al. (1993) [4] and Pizzale et al. (2002) [12]. The aim of present work is to investigate their antioxidant properties and total phenol contents of some plants cultivated in Turkey.

2.Materaia and Methods

2.1.Material: Materials were obtained from several locations of Turkey (Table1). Materials were brought in PVC containers. Samples were kept in sealed containers at -18^{o}C during study. A voucher specimens are kept in the herbarium of the Department of Biology, Selçuk University, and identified by Dr. Duran.

2.2.Method: The spices were dried, grounded and extracted in 90 % methanol + 9 % water + 1 % acetic acid mix. The extraction duration were 24 hour. After filtration, the filtrate were evaporated under vacuum, less than 45^{0}C. Folin-Ciocalteu colorimetric method were applied and the results were expressed as mg GAE/L extract [15]. Antioxidant activities in the latter samples were determined *in vitro* via scavenging of the Free radical scavenging activity were determined by DPPH method and the results were expressed as IC_{50} (mg/ml), minimum extract required to inhibit the 50 % percent of 1,1-diphenyl-2-picrylhydrazyl [6].

Table 1. Plants used in experiment

No	Voicher number	Plant name	Family	Localities
1	A.Duran 7723	*Cachrys crassiloba* (Boiss.) Meikle	Apiaceae	C3 Antalya: Akseki, Murtiçi, 500 m, 21.07.2007, rode side, field side.
2	A.Duran 7095	*Cachrys crassiloba* (Boiss.) Meikle	Apiaceae	C3 Antalya: Akseki, Murtiçi, 550 m, 15.08.2005, road side.
3	A.Duran 9016 & M. Öztürk	*Centaurea rigida* Banks. &Sol.	Asteraceae	C7 Şanlıurfa: Viranşehir-Siverek yolu, Karakeçili civarı, 806 m, 16.06.2010, field side, 37°28′580"N, 39°26′056"E.
4	A.Duran 8505	*Anthemis cretica* L. subsp. *albida* (Boiss.) Grierson	Asteraceae	C3 Konya: Seydişehir, Balıkova, Mavi boğaz, 1110 m, 29.05.2009, kanal boyu, valey inside.
5	A.Duran 9450 & Ö.Çetin, M.Çelik	*Centaurea verutum* L.	Asteraceae	C6 Kilis: Gaziantep-Kilis yolu, Şahinbey Anıtından sonra, 712 m, 14.07.2012, field side, 36°52′51"N, 37°21′02"E.
6	A.Duran 8679 & B.Doğan	*Cousinia boissieri* Buhse	Asteraceae	B9 Van: Gürpınar-Başkale road, Zernek Barajı civarı, 1925 m, 07.07.2009, step.
7	A.Duran 6317	*Centaurea amanicola* Hub.-Mor.	Asteraceae	C6 Osmaniye: between Yarpuz-Yağlıpınar , c. 1300 m, açık yeler, çalılıklar, 06.07.2003.
8	A.Duran 9450 & Ö.Çetin, M.Çelik	*Centaurea solstitialis* L.	Asteraceae	C6 Kilis: Gaziantep-Kilis yolu, after than Şahinbey Anıt, 712 m, 14.07.2012, road side, 36°52′51"N, 37°21′02"E.
9	A.Duran 9101	*Centaurea polyclada* DC.	Asteraceae	A1 Edirne: Enez, Gala village north, 5 m, 10.07.2010, road side, 35-T-434 798 E, 451 48 42 N
10	A.Duran 8463 & B.Doğan	*Scorzonera violacea* Chamberlain	Asteraceae	C3 Antalya: Gazipaşa, Çayıryaka yaylası, 1730 m, 30.06.2005, step, 36°30′027"N, 32°32′181"E
11	A.Duran 8637 & M.Öztürk	*Centaurea stapfiana* (Hand.-Mazz.) Wagenitz	Asteraceae	C8 Mardin: Bakırkırı, field side, 1025 m, 21.07.2009.
12	A.Duran 8730 & B.Doğan	*Centaurea ruthenica* Lam.	Asteraceae	B9 Ağrı: Patnos, Karakuyu village road, 1. km, 1681 m, 08.08.2009, road side, 39°20′040"N, 42°44′521"E.

13	A.Duran 9211	*Centaurea babylonica* (L.) L.	Asteraceae	C4 Antalya: between Gazipaşa-Saydaş, c. 250 m, *Pinus brutia* açıklığı, 36°30′013"N, 32°32′274"E
14	A.Duran 8423 & M.Öztürk	*Centaurea balsamita* Lam.	Asteraceae	C7 Adıyaman: between Atatürk Barajı-Bozova, ca. 9. km, 497 m, field side.
15	A.Duran 7326	*Anthemis cuneata* Hub.-Mor. & Reese	Asteraceae	C2 Muğla: Fethiye, Korkuteli road, ca. 30 km, 1000 m, 25.07.2006, road side, marnlı alanlar, 36°45′042"N, 29°27′381"E.
16	A.Duran 8097 & M.Öztürk, Ö.Çetin	*Erysimum kotschyana* J.Gay	Brassicaceae	C3 Denizli: Honaz Mountain, Baba hill North-east, 2345 m, 17.07.2008, rock step.
17	A.Duran 7643	*Fibigia clypeata* Medik subsp. *clypeata* var. *eriocarpa* (DC.) J.Thiébaut	Brassicaceae	C5 Niğde: Ulukışla, between Çiftehan-Pozantı , 2. km, c. 1000 m, 01.08.2007, rayway side.
18	A.Duran 7558	*Sterigmostemum incanum* M.Bieb.	Brassicaceae	A8 Erzurum: Tortum-Uzundere yolu, c. 10. km, 1440 m, 12.07.2007, road side, eğimli yerler, 40°22′218"N, 41°30′230"E.
19	A.Duran 2813	*Aethionema oppositifolium* Pers. & Hedge	Brassicaceae	C3 Antalya: Akseki, Çukurköy yaylası, Yumrudikmeni mevkii, 2200 m, 16.07.1995, rock area.
20	M.Öztürk 1515 & A.Duran	*Malcolmia africana* (L.)R.Br.	Brassicaceae	C3: Antalya: Manavgat-Alanya yolu, Akseki kavşağından 3.5 km sonra, 07.05.2010, sea side, sandy.
21	M.Öztürk 942	*Sterigmostemum incanum* M.Bieb.	Brassicaceae	B5 Aksaray: Nizip, Kireçlik mevkii, 1050 m, 13.08.2005, river inside.
22	A.Duran 6717 & E.Hamzaoğlu	*Aethionema dumanii* Vural & Adigüzel	Brassicaceae	B4 Ankara: Polatlı-Yunak yolu, 41. km, Yaralı köyü sağından 3. km, 800 m, 03.07.2004, kireçli step
23	A.Duran 8029 & B.Doğan	*Silene leptoclada* Boiss.	Caryophyllaceae	B5 Kayseri: Yahyalı, Karpuzbaşı Şelalesi, Aladağ Road, 15. km, 1080 m, 03.07.2008, serpantin taşlı yerler.
24	A.Duran 7143	*Silene cappadocica* Boiss. & Heldr.	Caryophyllaceae	C4 Konya: Kulu, Tuzyaka'dan lake side, 910 m, 27.05.2006, step, 38°56'348"N, 33°18′859"E
25	A.Duran 8709 & B.Doğan	*Silene araratica* Schischk.	Caryophyllaceae	C9 Hakkari: Cilo Mountain, Kırıkdağ village-Cehennem Dere yaylası arası, 2530 m, 07.08.2009, kaya çatlağı, 37°32′021"N, 43°58′726"E
26	A.Duran 4169	*Lathyrus tauricola* P.H.Davis	Fabaceae	C3 Antalya: Akseki-Cevizli road, 22. km. 1250 m. 21.06.1997 *Juniperus excelsa* açıklığı, kalker rock area.
27	A.Duran 7334	*Astragalus schizopterus* Boiss.	Fabaceae	C3 Burdur: Dirmil-Gölhisar, 7. km, 1175 m, açık yerler, 37°03′236"N, 29°32′076"E.
28	A.Duran 8143 & M.Öztürk, Ö.Çetin	*Genista vuralii* A.Duran & Dural	Fabaceae	A4 Çankırı: Ilgaz Dağı, vericiler round, 1400 m, 20.08.2008, forestry area
29	A.Duran 8964	*Stachys germanica* L. subsp. *bithynica* (Boiss.) R.Bhattacharjee	Lamiaceae	B6 Kayseri: Sarız, Yalak (Yeşilkent), Binboğa Dağı, 2400 m, 07.08.2009, rocky area.
30	A.Duran 7322	*Teucrium sandrasicum* O.Schwarz	Lamiaceae	C2 Muğla, Köyceğiz, Ağla, Sandras Mountain, Gölden 2 km sonra, 1830 m, 23.07.2006, *Pinus nigra* açıklığı, 37°02′987″N, 28°48′442″E.

Table 2. Antioxiandt activit and total phenol contents of medicinal plants belong to some families

Plant names	**Antioxidant activity (%)**	**Total phenol (mg GAE/100ml)**
Erysimum kotschyana J.Gay	70.074	0.767
Centaurea rigida	70.813	0.629
Anthemis cretica L.	80.911	1.277
Stachys germanica L.	80.049	1.064
Centaurea verutum L.	62.192	0.881
Fibigia clypeata	54.557	0.495
Cousinia boissieri	79.557	0.614
Centaurea amanicola	79.310	0.975
Sterigmostemum incanum	67.857	0.748
Centaurea solstitialis	81.034	0.777
Centaurea polyclada DC.	81.281	1.188
Silene leptoclada Boiss.	45.074	1.302
Cachrys crassiloba (Boiss.)	67.611	0.708
Silene cappadocica Boiss.	73.645	0.668
Scorzonera violacea	81.034	0.881
Centaurea stapfiana	80.788	0.832
Silene araratica	56.281	0.668
Aethionema oppositifolium (pers.) hedge	81.158	3.337
Lathyrus tauricola	79.803	1.099
Centaurea ruthenica Lam.	44.089	0.411
Centaurea babylonica L.	81.527	0.693
Centaurea balsamita Lam.	81.527	2.708
Molcolmia africana L.	80.296	1.282
Sterigmostemum incanum	72.537	0.802
Astragalus schizopterus	57.266	1.129
Genista vuralii	77.956	2.272
Anthemis cuneata	81.404	1.074
Aethionema dumanii	78.941	3.267
Cachrys crassiloba Boiss.	81.281	2.153
Teucrium sandrasicum	80.788	2.931

3.Results and Discussion

In current study, the total phenolic amounts and antioxidant capacity of plant (belong to few families) extracts obtained from common plant species collected from different places in Turkey were evaluated. Aerial parts of the plants were stored until needed. The total phenolic contents and antioxidant capacity are given in Table 2.

The results showed that the total phenolics varied significantly and ranged from 0.411 mg GAE/100 ml to 3.337 mg GAE/100 ml. The highest phenolic contents was determined in *Aethionenmu devmonii*. *Centaurea aumosiensis* had a slightly lower total phenolic content than those reported by Rababah et al. (2011) [13].

Among the investigated plants, plants belong to the *Brassicaceae, Asteraceae, Fabaceae, Brassicaceae, Apiaceae and Lamiaceae* (6717, 8423, 8143, 6717, 7095 and 7322, respectively) had the highest contents of phenolic. Alali et al. (2007) [2] reported that total phenolic content of aqueous and methanolic extracts of Centaurea ammocyanus Boiss and Scorzonera syriaca were found as 18.1 mg GE/g to 10.9 mg GE/g and 15.1 mg GE/g to 11.2 mg GE/g, respectively. Many plants species displayed remarkably high levels of total phenolic content. Our results were found lower compared with literature [1,2,7,13]. The total phenolic contents of 32 selected herbs collected from Grabowo in Poland ranged from 0.07 to 15.2 mg of gallic acid equivalents (GAE)/ 100 g dw [18].

The highest antioxidant activity was that of *Centaurea babylonica* (L.) (81.527 %). Mihauskas et al. (2004) [11] studied many plants of the Lamiaceae family and found that Salvia officinalis had the strongest antioxidant activity. The results were higher than those reported by Rababah et al. (2011) [13]. Antioxidant activity of plant extracts by the DPPH scavenger method (inhibition %) were found between 45.074% (*Silene lephackola*) to 81.527% (*C.babylonica* L.). Antioxidant values reported by Kulisic et al. (2006) [8] for *Origanum vulgare* L. (85%) was higher than those found in *Centaurea babylonica* (81.527%), *Centaurea polyclada* DC (81.281%) and *Anthemis cuneata* (81.404%) in this study. The results presented in Table 2 shown differences with Rababah et al. (2011) [13], who found that although some plants have a higher phenolic content, their antioxidant activities are lower, and this could be due to the type of phenolic compounds found in the plants. There was a significant linear correlation between total phenolic content and antioxidant activity of the plant extracts. Result shown that the phenolic compounds contributed significantly to the antioxidant activity of the studied plant species. Future research should be identify and describe new structural classes of natural phenolic compounds and antioxidant compounds.

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Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

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