Erzincan Binali Yıldırım Üniversitesi
Fen Bilimleri Enstitüsü Dergisi
2020, 13(2), 803-810
ISSN: 1307-9085, e-ISSN: 2149-4584
Araştırma Makalesi

Erzincan Binali Yıldırım University
Journal of Science and Technology
2020, 13(2), 803-810
DOI: 10.18185/erzifbed.731700
Research Article

Antioxidant Activity and Chemical Content of Infusions of Asparagus L. Plant in Different Concentrations

Hasan KILIÇGÜN[1*]

[1]Erzincan Binali Yıldırım Üniversitesi, Sağlık Bilimleri Fakültesi, Beslenme ve Diyetetik Bölümü, 24030, Erzincan, Türkiye

Geliş / Received: 04/05/2020, Kabul / Accepted: 12/08/2020

Abstract

In this study, *in vitro* antioxidant activity and chemical content of different concentrations of Asparagus L. plant, growing naturally in Çayırlı District of Erzincan Province, were investigated. It was observed that *Asparagus* L. plant had antioxidant activity in all concentrations of parameters in which antioxidant activity was determined *in vitro*. However, the best activity was at a concentration of 4%. As a result of the chemical content analysis, it showed a linear increase in the phenolic content depending on the concentration, and the idea that the antioxidant activity is related to the phenolic content. On the other hand, the low Na content of asparagus can be used as an important food source for blood pressure patients. Being rich in terms of potassium, calcium, magnesium and phosphorus content shows that it may be a good alternative to cultivated plants. The fact that asparagus contains iron, copper, zinc and manganese also shows that the plant is rich in mineral substances. In addition, its high vitamin C content suggests that vitamin C is one reason why asparagus has an antioxidant effect. When the data obtained in this study were evaluated; Asparagus shows that it contains a significant amount of bioactive compounds, especially antioxidants that have beneficial effects on human health, and is a nutritionally well-balanced edible plant.

Keywords: Asparagus, chemical content, nutritional quality, bioactive compounds,

Asparagus L. Bitkisinin Farklı Konsantrasyonlardaki İnfüzyonlarının Antioksidan Aktivitesi ve Kimyasal İçeriği

Öz

Bu çalışmada Erzincan İli, Çayırlı İlçesi sınırlarında doğal olarak yetişen: *Asparagus L.* bitkisinin farklı konsantrasyonlardaki infüzyonlarının *in vitro* antioksidan aktivitesi ve kimyasal içeriği incelendi. *Asparagus* L. bitkisinin *in vitro* antioksidan aktivite tayinin yapıldığı parametrelerin bütün konsantrasyonlarında antioksidan aktiviteye sahip olduğu görüldü. Bununla birlikte en iyi aktivitenin ise bütün parametrelerde %4'lük konsantrasyonda olduğu belirlendi. Öte yandan, yapılan kimyasal içerik analizi sonucunda *Asparagus L.*'nin fenolik içeriği konsantrasyona bağlı olarak lineer bir artış göstermesi, antioksidan aktivitesinin fenolik içerik ile ilişkili olduğu düşüncesini ortaya çıkardı. Diğer taraftan bu yabani bitkinin Na içeriği düşük olması, bu bitkinin tansiyon hastaları için önemli besin kaynağı olarak kullanılabileceğini düşündürmektedir. Potasyum, kalsiyum, magnezyum ve fosfor içeriği yönünden, zengin olması kültür bitkilerine iyi bir alternatif

*Corresponding Author: hkilicgun@erzincan.edu.tr

olabileceğini göstermektedir. Kuşkonmazın demir, bakır, çinko ve mangan ihtiva etmesi de bitkinin mineral madde bakımından zengin olduğunu göstermektedir. Ayrıca yüksek C vitamini içeriği, kuşkonmazın antioksidan etki göstermesinin bir nedeninin de C vitamini olduğunu düşündürmektedir. Bu çalışmada elde edilen veriler değerlendirildiğinde; kuşkonmazın, önemli ölçüde biyoaktif bileşikler içermesi, özellikle de insan sağlığı üzerinde faydalı etkileri olan antioksidanları içermesi besinsel olarak iyi dengelenmiş yenilebilir bitki olduğunu göstermektedir.

Anahtar Kelimeler: Kuşkonmaz, kimyasal bileşim, beslenme kalitesi, biyoaktif bileşikler

1. Introduction

The genus *Asparagus* L. (Asparagus) is a member of the Monocotyledones class and the Liliaceae family. The origin of asparagus is believed to be in the Eastern Mediterranean, but also grows in Central Europe, the Caucasus and Western Asia. Centuries ago, it was taken by immigrants to North America, North Europe and South America, North Africa and some parts of Australia. (Chase et.al., 2016; Pegiou et.al.,2020) 11 species and 12 taxa grow naturally in our country. The genus includes monoic and dioic species. All of the species growing in Turkey is dioica (Davis, 1984). Asparagus was first cultured by the ancient Egyptians, and it has been bred for thousands of years by many ancient civilizations, including the Greeks and Romans (Winter, 2009). The culture of the cultivated forms of asparagus naturally grown and perennial in our country is carried out mainly in France, Italy, Germany, USA and Japan (Güvenç, 1997). Traditionally, Asparagus species have been used for the treatment of urinary problems, particularly as a herbal medicine source in China and Korea (Chase et.al., 2016; Al-Snafi, 2015; Negi et al., 2010). Asparagus root extracts in India have been used to strengthen the female reproductive system, increase fertility and increase breast milk production (Chase et.al., 2016). In both Far East and Greek medicine, asparagus extracts have been used as a tonic for the prevention and treatment of various ailments, including kidney, bladder, rheumatic disease, liver disease, asthma and cancer (Chase et.al., 2016; Al-Snafi, 2015; Hafizur et al., 2012; Ahad and Nissar, 2017). In this context, the main purpose of this study is to support the possible cultivation studies and to contribute to the country's economy by determining the antioxidant activity and chemical composition of Asparagus naturally grown in Erzincan Province.

2. Material and Method

In this study, a main stock infusion of 4% was prepared from *Asparagus* L. plant shoots that naturally grow on the slopes and roadsides on the slopes and roadsides between April-May in Çayırlı District, Yurekli Village and Ortaçat Village. It was diluted to2% and 1% infusions. The results obtained from these infusions were compared with the control group. In *in vitro* experiments, *Asparagus* L. in lipid oxidation (thiocyanate method) (Mitsuda et.al., 1966), protein oxidation (carbonyl and Lenz methods) (Levineet al., 1990), the control groups of these parameters (lipid oxidation and protein oxidation) did not include the antioxidant solvent. Thus, they had not any inhibition activities on oxidation. Carbohydrate damage (deoxyribose method) (Halliwell et al., 1987), oxidative DNA damage (Aruoma et al) (Halliwell and Aruoma, 1991) methods have been used. The control groups of these

parameters(Carbohydrate damage and oxidative DNA damage) was prepared in a way that does not contain antioxidant solution. That's why, the controls had the most damage effects. Total phenol content was measured according to the Folin-Ciocalteu method (Singleton and Rossi, 1965; Aydın, 2012) In the chemical content examination, the shoots of the collected plant were weighed and dried to a constant weight at 65-70 ° C for dry matter determination (Green, 1992); ascorbic acid titrimetrically (Costan etal.,2019) and pH measured by digital pH meter (Wright and Kader, 1996); in sodium and potassium amount (Bekman Systeme); calcium, phosphorus, magnesium analysis in Automatic Analyzer (Hitachi-705); iron, copper, zinc, manganese analyzes were done in Atomic Absorption Spectrophotometer (PerkinElmerA Analyst 700). Data are presented as mean ± SD of at least three independent experiments (n = 3). One-way analysis of variance (ANOVA) followed by Scheffe's test were performed to determine statistical differences between groups with the aid of SPSS software version 15.0 (SPSS, Chicago, IL, USA). Statistical significance was defined as $P < 0.05$ for all tests.

3. Results:

Considering the Total Phenol Content and antioxidant activity results of the asparagus plant, it was observed that there was an increase in concentration and total phenol content and in vitro antioxidant activity in all parameters Table 1, Table 2. When the mineral substance content of the asparagus was examined plant, it has been determined that Sodium content 2 mg / 100g, Potassium content 280 mg. / 100g, Calcium content 40mg / 100g, Magnesium content 20mg / 100g Phosphorus content 90mg / 100g, Iron content 1.8mg / 100g, Copper content 0.20mg / 100g, Zinc content 0.62mg / 100g and Manganese content 0.6mg / 100g Table 3. In addition, the dry matter, pH and Vitamin C content of the asparagus plant were examined. it was determined that the dry made content was approximately 20.58 percent, the pH was approximately 5.46, and the vitamin C content was approximately 43.31mg per 100 grams Table 4.

Table 1: *In vitro* Antioxidant Activity of Asparagus Concentrations

	Control	**1%**	**2%**	**4%**
Lipid Oxidation (% inhibition)	0,00	42,00 ± 0,02a	73,20 ± 0,06b	78,50 ± 0,08c
Protein Oxidation (% inhibition)	0,00	56,30 ± 0,30a	64,06 ± 0,01b	72,09 ± 0,04b
Carbohydrate damage (A532)	0,268 ± 0,001a	0,241 ± 0,002b	0,216 ± 0,003c	0,184 ± 0,005d
DNA damage (A_{532})	0,265 ± 0,003a	0,186 ± 0,001b	0,0112 ± 0,003c	0,96 ± 0,001d

***Different letters (a,b,c,d) on the same line show statistical difference among groups P<0.05**

Table 2: Total Phenol Content of Asparagus Concentrations

	1%	**2%**	**4%**
Total phenol content (mg / l catechin equivalent)	195,0 ±4.20a	324,6 ±6,35b	486,40 ±6,55c

*** Different letters (a,b,c) on the same line show statistical difference among groups P<0.05**

Table 3: Mineral substance content of asparagus plant

Mineraller (mg/100g)								
Na	K	Ca	Mg	P	Fe	Cu	Zn	Mn
2	280	40	20	90	1.8	0.20	0.62	0.6

Table 4: Dry matter, pH and Vitamin C content of asparagus plant

Dry matter amount (%)	pH	Ascorbic acid (mg/100 g)
20.58 ±1.198	5.46 ± 0.013	43.31±0.200

4. Conclusion

Conclusion and Discussion:

Consisting of about 300 species, Asparagus is an important global product that is increasing in importance. It has been used by herbalists for the regulation of diabetes, dysentery, epilepsy, night blindness, hypercholesteremia, main reproductive hormones and oogenesis in mammals from the past (Peter, 2007; Visavadiya and Narasimhacharya, 2009) In studies with different asparagus species, it has been reported that these species, including saponins and flavonoids, are rich in phenolic compounds (Negi et al., 2010; Zhang et al., 2019). In this study, it was determined that the total phenol content of asparagus showed a linear increase depending on the dose Table 2. On the other hand, studies on saponins in asparagus species were found to reduce LDL and total cholesterol levels due to hypolipidemic effects of asparagus (García et al., 2012; , Vázquez-Castilla et al., 2013). In this study, it was determined that asparagus strongly inhibits lipid peroxidation depending on the dosage, and this activity was determined to reach the highest level, especially in a concentration of 4% (Table 1). Asparagus is a valuable food source of various vitamins and as a result of the vitamin content of vegetables worldwide, asparagus is in the 10th ranks. These vitamins such as itamin B6, vitamin B12 and vitamin B9 contribute to maintaining homocysteine level. High homocysteine levels reduce the risk of atherosclerosis and other cardiac disorders (Tucker et al., 2004). In addition, folate plays an important role in metabolism, cell division and DNA formation, as well as maintaining healthy homocysteine levels in the body by conversion (Ross, 2014). In this study, it is thought that high vitamin C in asparagus also contributes to the reduction of DNA damage and protein oxidation (Table 1 and 4). Studies have reported that vitamins in asparagus are effective in the biosynthesis of DNA, amino acids and fatty acids (Watanabe et al., 2014). In addition, it was determined in this study that asparagus inhibits carbohydrate damage at all doses and this inhibition increases in parallel with the dose increase. In the literature review conducted, no study indicating that asparagus prevents carbohydrate damage was found. Considering the mineral content of asparagus (Pegiou et al., 2020; Guo, et al., 2020), the low Na content of this wild plant suggests that this plant can be used as an important food source for blood pressure patients (Table 3). Wild asparagus plant is rich in terms of potassium, calcium, magnesium and phosphorus content. These aspects show that it may be a good alternative to cultivated plant. Because of the fact that asparagus contains iron, copper, zinc and manganese (Table 3), the contribution of these basic minerals to human nutrition enables it to be a good alternative to cultivated plant. On the other hand, the mineral content of the asparagus plant, which was not cultured, was found to be quite good (Table 4). In conclusion, these results strongly supported that not cultured asparagus plant has a rich antioxidant activity mineral and vitamin contents for possible healthy lifestyles of humans. Also, more chemical and pharmacological studies are needed to make more use of asparagus species naturally grown in our country.

5. References

Chase, M.W., Christenhusz, M., Fay, M., Byng, J., Judd, W.S., Soltis, D., Mabberley, D., Sennikov, A., Soltis, P.S., Stevens, P.F. 2016. "An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV", *Botanical Journal of the Linnean Society*, 181, 1–20.

Pegiou, E., Mumm, R., Acharya, P., de Vos, R. C., & Hall, R. D. 2020. "Green and White Asparagus (Asparagus officinalis): A Source of Developmental, Chemical and Urinary Intrigue", *Metabolites*, 10(1), 17.

Davis, PH.1984."Flora of Turkey and the east Aegean Islands". Vol. 8 *University press,* Edinburg.

Winter, R. A. 2009. "Consumer's Dictionary of Cosmetic Ingredients 7th ed" Complete Information About the Harmful and Desirable Ingredients Found in Cosmetics and Cosmeceuticals; *Three Rivers Press: New York, NY, USA.*

Güvenç, A. 1997. "Asparagus L. türlerinin taşıdığı etken bileşikler ve kullanılışları", *Ankara Üniversitesi Eczacılık Fakültesi Dergisi*, 26(1), 52-75.

Al-Snafi, A.E. 2015. "The pharmacological importance of Asparagus officinalis-A review", *Pharmaceutical Biology*, 5, 93–98.

Negi, J., Singh, P., Joshi, G., Rawat, M., Bisht, V. 2010. "Chemical constituents of Asparagus", *Pharmacognosy Reviews,* 4, 215.

Hafizur, R.M., Kabir, N., Chishti, S. 2012. "Asparagus officinalis extract controls blood glucose by improving insulin secretion and *b*-cell function in streptozotocin-induced type 2 diabetic rats", *British Journal of Nutrition*, 108, 1586–1595.

Ahad, T., Nissar, J.2017."Metabolomic and its approach in food science" *The Pharma Innovation Journal* , 6, 745–756.

Mitsuda, H., Yasumoto, K., lwami, K. 1966. "Antioxidative action of indole compounds during the autoxidation of linoleic acid", *Eiyoto Shokuryo*, 19, 210-214.

Levine, R.L., Garland, D., Oliver, C.N., Amici, A., Climent, I., Lenz, A., Ahn, B., Shaltiel, S., Stadtman, E.R. 1990. "Determination of carbonyl content in oxidatively modified proteins", *Methods in Enzymology*, 186, 464-478.

Halliwell, B., Gutteridge, J.M., Aruoma, O.I.1987. "The deoxyribose method: A simple "test-tube" assay for determination of rate constants for reactions of hydroxyl radicals", *Analytical Biochemistry*, 165, 215-219.

Halliwell, B., Aruoma, O.I.1991. "DNA damage by oxygen-derived species. Its mechanism and measurement in mammalian systems", *FEBS Letters*, 281, 9-19.

Singleton, V.L., Rossi, J.A. 1965. "Colorimetry of Total Phenolics with Phospho-molybdic-Phosphtungstic Acid Reagents", *American Journal of Enology and Viticulture*, 16, 144-158.

Aydın, Ç. 2012. "Denizli İlinde Yayılış Gösteren Bazı Endemik Allıum L. Taksonlarının Ekstraktlarının Aktif Bileşenlerinin Karakterizasyonu, Antioksidan ve Antibakteriyal Etkilerinin Belirlenmesi", Yüksek Lisans Tezi, *Fen Bilimleri Enstitüsü*, Denizli.

Green, C. 1992. "An Overview of Production and Supply Trends in the U.S. Specialty Vegetable Market", *Acta Horticulture,* 318, 41-45.

Costan, A., Stamatakis, A., Chrysargyris, A., Petropoulos, S.A., Tzortzakis, N. 2019. "Interactive effects of salinity and silicon

application on Solanum lycopersicum growth, physiology and shelf-life of fruit produced hydroponically", *Journal of the Science of Food and Agriculture*, 100(2), 732-743.

Wright, K.P. and Kader, A. 1996. "Effect of Slicing and Controlled-Atmosphere Stor-age the Ascorbate Content and Quality of Strawberries and Persimmon" *Post-Harvest Biology and Technology* 10, 39-48.

Peter, K. 2007. "Underutilized and Underexploited Horticultural Crops; Number v. 2 in Underutilized and Underexploited Horticultural Crops" *New India Publishing Agency*: New Delhi, India.

Visavadiya, N.P., Narasimhacharya, A. 2009. "Asparagus root regulates cholesterol metabolism and improves antioxidantstatus in hypercholesteremic rats" *Evidence-based Complementary and Alternative Medicine*, 6, 219–226.

Zhang, H., Birch, J., Pei, J., Ma, Z.F., Bekhit, A.E.D. 2019. "Phytochemical compounds and biological activity in Asparagus roots: A review", *International Journal of Food Science & Technology*, 54, 966–977.

García, M., De la Puerta, R., Sáenz, M., Marquez-Martín, A., Fernández-Arche, M. 2012. "Hypocholesterolemic and hepatoprotective effects of "Triguero" Asparagus from Andalusia in rats fed a high cholesterol diet", *Evidence-based Complementary and Alternatative Medicine*,1-6.

Vázquez-Castilla, S., De la Puerta, R., Garcia-Gimenez, M., Fernández-Arche, M., Guillén-Bejarano, R. 2013. **"**Bioactive constituents from "Triguero" asparagus improve the plasma lipid profile and liver antioxidant status in hypercholesterolemic rats" *International Journal of Molecular Sciences,* 14, 21227–21239.

Tucker, K.L., Olson, B., Bakun, P., Dallal, G.E., Selhub, J., Rosenberg, I.H. 2004. "Breakfast cereal fortified with folic acid, vitamin B-6, and vitamin B-12 increases vitamin concentrations and reduces homocysteine concentrations: A randomized trial", *The American Journal of Clinical Nutrition*, 79, 805–811.

Ross, A. (2014). "Modern Nutrition in Health and Disease; M-Medicine Series", *Wolters Kluwer Health/Lippincott Williams & Wilkins*: Philadelphia, PA, USA.

Watanabe, F., Yabuta, Y., Bito, T., Teng, F. 2014. "Vitamin B12-containing plant food sources for vegetarians", *Nutrients*, 6, 1861–1873.

Guo, Q., Wang, N., Liu, H., Li, Z., Lu, L., & Wang, C. 2020. The bioactive compounds and biological functions of Asparagus officinalis L.–A review. *Journal of Functional Foods*, *65*, 103727.