IAAOJ, Scientific Science, 2013,1(1),9-12

SOME CHEMICAL PROPERTIES OF CHESTNUT (*CASTANEA SATIVA* MILL.) FRUIT COLLECTED FROM DIFFERENT LOCATIONS IN TURKEY

Asst.Prof.Dr. Fatih Er[1], Prof.Dr. Mehmet Musa Özcan[2], Asst.Prof.Dr. Erman Duman[3], Lec.Dr.Züleyha Endes[2]

[1] High College, Program of Agricultural Machinery, Selçuk University , 42031 Konya, Turkey
[2]Department of Food Engineering, Faculty of Agriculture, Selçuk University, 42031 Konya, Turkey
[3]Department of Food Engineering, Faculty of Engineering, Afyon Kocatepe University, Afyonkarahisar, Turkey
[2]Correspond e-mail: mozcan@selcuk.edu.tr

ÖZET

Bu çalışmada, farklı lokasyonlardan toplanan tamamen olgunlaşmış kestane (*Castanea sativa* Mill.) meyveleri'nin kimyasal özellikleri (nem, kül, ham yağ, ham lif, toplam karbonhidrat, toplam fenol ve mineral madde içeriği) belirlenmiştir. Kestane meyveleri'nin toplam fenol içeriği 21.8-24.7 g GAE/100 g arasında değişmiştir. Kestane meyvesi'nin bazı makro ve micro element içerikleri ICP-AES ile tespit edilmiştir. Kestaneler farklı miktarlarda Ca, Mg, K, P, Na ve Zn içermektedir. Bu değerler, sırasıyla 2090-2710 ppm, 1216-1713 ppm, 10719-14867 ppm, 1627-1849 ppm, 297-418 ppm ve 47-79 ppm bulunmuştur.

Anahtar Kelimeler: Kestane, *Castanea sativa*, mineraller, fiziksel ve kimyasal özellikler

ABSTRACT

Chemical properties (including moisture, ash, crude oil, crude protein, crude fibre, total carbohydrate, total phenol and minerals) of completely ripe chestnut (*Castanea sativa* Mill.) fruits collected from different locations (Aydın, Bursa and Kastamonu) were determined. Total phenol contents of chestnut fruits changed between 21.8-24.7 g GAE/100 g extract. The some macro and micro element contents of chestnut fruit were determined by Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES). The chestnuts contained different amounts of Ca, Mg, K, P, Na and Zn. These values were found as 2090-2710 ppm, 1216-1713 ppm, 10719-14867 ppm, 1627-1849 ppm, 297-418 ppm, and 47-79 ppm, respectively.

Keywords: Chestnut, *Castanea sativa*, minerals, physical and chemical properties

1. Introduction

Chestnuts have been cultivated for centuries. Anatolia in Turkey is the motherland and one of the oldest cultivation area of chestnut (*Castanea sativa* Mill.) (Ertürk et al. 2006). Chestnuts (*Castanea sativa*), a member of the family Fagaceae, is annual plant which grows in Turkey. Turkey is the motherland and one of the oldest cultivation area of chestnut (*Castanea sativa* Mill.) (Ertürk et al. 2006). There are four main economic species of chestnut: *Castanea crenata* (Japanese), *C. dentata* (American), *C. mollissima* (Chinese) and *C. sativa* (European). All chestnut species are native to the northern hemisphere. Chestnut is a deciduous tree or shrub, which is cultivated in a similar manner to other deciduous nut trees. It bears brown nuts, about an inch in diameter, which are usually consumed after they are roasted. From one to nine nuts are produced in a spiny involucres or burr (Clapper, 1954; Burnham, 1988). In Europe , chestnuts are thought to have introduced by Greeks in north-west and central Europe. The oldest planted sweet chestnut in England is the chestnut. It was commonly found on mountains, hills, and slopes in gravelly or rocky, well-drained glacial soils (Jaynes, 1979; Anonymous, 2004). Chestnuts are often used as a substitute for potatoes or pasta in Europe due to their high starch content. Mashed or whole braised chestnuts are good partners with sweet potatoes, Brussels sprouts and cabbage, but most Turkish people use them in deserts. Chestnuts have a remarkable nutritional composition. Fresh chestnuts contain about 50% moisture. They contain complex carbohydrates are low in protein (about 5%), are very low in fat, have reasonable quantities of vitamin C and potassium and are very low in sodium. The protein is high quality (comparable to eggs), and is easily assimilated by the human body (Sander, 1974). The aim of current study is to determine the moisture, ash, crude oil, crude protein, crude fibre, total carbohydrate, total phenol and minerals contents.

2. Material and Method

2.1. Material

Each chestnut fruits were collected from ten chestnut trees growing from Aydın, Bursa and Kastamonu in October 2011. This research was performed by three duplicates. The fruits were transported in polypropylene bags and held at room temperature. Fruits were cleaned by a combination of manual and mechanical means to get rid of all foreign matter and crushed and immature fruits. Moisture contents were measured immediately on arrival soon.

2.2. Method

Moisture, crude oil, crude protein, ash, crude fibre and total carbohydrate according to (AOAC,1994; Çağlarırmak, 2003). Dinitrophenol method was utilised in the analysis of total carbohydrates (Ross, 1959; Ertürk et al. 2006) using the Schmadzu Spectrophotometer. Total phenolic amount of extracted spice and tea plant species were made according to Singleton and Rossi (1965) by using Folin-Ciocalteu Calorimetric method. Results were calculated as mg gallic acid equivalent by using calibration curve which is obtained from solutions prepared from gallic acid. Analysis was made with three parallels.

2.3. Determination of mineral contents

Collected samples were dried at 70 ºC in a drying cabinet with air-circulation until they reached constant weight. Later, about 0.5 g dried and ground sample was digested by using 5ml of 65% HNO_3 and 2 ml of 35% H_2O_2 in a closed microwave system (Cem-MARS Xpress). The volumes of the digested samples were completed to 20 ml with ultra-deionized water and mineral concentrations were determined by inductively coupled plasma-optical emission spectroscopy (ICP AES; (Varian-Vista, Australia). Measurements of mineral concentrations were checked using the certified values of the related minerals in the reference samples received from the National Institute of Standards and Technology (NIST; Gaithersburg, MD, USA) (Skujins,1998).

Working conditions of ICP-AES:

Instrument :ICP-AES (Varian-Vista)
RF Power : 0.7-1.5 kw (1.2-1.3 kw for Axial)
Plasma gas flow rate (Ar) : 10.5-15 L/min. (radial) 15 " (axial)
Auxilary gas flow rate (Ar) :1.5 "
Viewing height : 5-12 mm
Copy and reading time :1-5 s (max.60 s)
Copy time : 3 s (max. 100 s)

2.4. Statistical analyses

Results of the research were analysed for statistical significance by analysis of variance (Püskülcü and İkiz, 1989).

3. Results and Discussion

The chemical properties of chestnut fruits collected different locations are shown in Table 1. Moisture, crude oil, crude protein, crude fibre, ash and total carbohydrates values were determined as 52.6-56.9%, 2.2-3.5%, 4.4-6.3%, 2.3-3.7%, 2.1-2.7% and 73.2-81.3%, respectively. The ash content of the chestnut cultivars changed between 1.02 and 3.22 g/100 g (Ertürk et al. 2006). Many other researchers found this value between 0.83 and 4.92 g/100 g in various species and genotypes (Brighenti et al. 1998; Üstün et al. 1999; Demiate et al., 2001). The crude cellulose quantities of the chestnut cultivars ranged from 3.58 to 5.96 g/100 g (Ertürk et al. 2006). Demiate et al. (2001) found the crude cellulose quantity in Brezilian cultivars (*C.sativa*) as 2.34 g/100 g. The total fat content of the chestnut samples ranged from 0.49 to 2.01 g/100 g (Ertürk, 2006). This value was found between 0.66 and 5.59 g/100 g by some other researchers in the cultivars belonging to the species C.sativa Mill. (Ferreria-Cardoso et al. 1993; Brighenti et al. 1998; Üstün et al. 1999; Demiate et al., 2001). Total protein quantity of chestnut cultivars changed between 4.88 and 10.87 g /100 g, but it was between 5.23 and 8.73 g/100 g in most of the samples (Ertürk et al. 2006). Total phenol of *Castanea sativa* Mill. is presented in Table 1. In current study, it was partly a change in the total phenol values of *Castanea sativa* Mill. Methanol extracts depending on locations. But, Aydın chestnut showed the highest Absorbams values. With respect to the total phenols yields referred to the chestnut fruit, total phenol contents changed between 21.8-24.7 g GAE/100 g extract. Total phenol contents of chestnut extracts ranged from 2.15-10.26 g GAE/100 g (Barreira et al., 2008). The mineral contents of chestnut fruit were determined by ICP-AES (Table 1.). The chestnuts contained different

amounts of Ca, Mg, K, P, Na and Zn. These values were found as 2090-2710 ppm, 1216-1713 ppm, 10719-14867 ppm, 1627-1849 ppm, 297-418 ppm, and 47-79 ppm, respectively. The chestnut cultivars contained different amounts of Ca, Mg, Fe, Mn, Cu, Zn, P and K. These values were found as 43-230 mg/100g , 70-160 mg/100g, 0.4-5.7 mg/100g, 0.7-5.5 mg/100 g, 0.6-3.8 mg/100 g,1.8-9.1 mg/100 g, 6.0-41.0 mg/100 g and 761-1271 mg/100 g, respectively (Ertürk, 2006). Chestnut fruits contain crude protein and K at high levels.

As a results, K and P contents of fruits collected from Bursa province were found high compared with other fruits.Total carbohydrate, total phenol, Mg and Na contents of Aydın fruits were found high than those of Bursa and Kastamonu chestnut fruit results. Chestnut fruits have advantage over fruits such as peanut, hazelnut and walnut in terms of certain mineral concentrations: Fe, Ca, Mn, Mg, Na, Zn and K. Calcium is the major component of bone and assists in teeth development (Brody, 1994; Macrae et al. 1993).

Acknowledgement: This study was supported by Selcuk University Scientific Research Project (S.Ü.-BAP, Konya-Turkey). Also, the authors wish to thank to BAP Staffs.

References

Anonymous, 2004. Available:http://www.ncnatural.com/NCNatural/trees/chestnut.html

Brody, T. 1994. *Nutritional Biochemistry* , pp 555-556, San Diego, CA: Academic Press.

Brighenti,F., Campagnolo,M., Bassi,D.1998. Biochemical characterization of the seed in instinet chestnut genotypes (*C.sativa*). In: International Symposium on Chestnut, Bordeaux, Proceedings, Bordeaux,France.

Burnham, C.R. 1988. The restoration of the American chestnut. American Scientist *76*, 478- 487.

Clapper, R.B. 1954. Chestnut Breeeding, Techniques and Results. II Inheritance of characters, Breeding for vigar and Mutations. Journal of Hered *45*: 201-208.

Çağlarırmak, N.2003. Biochemical and physical properties of some walnut genotypes (*Juglans regia* L.). Nahrurg/Food 47(1),28-32.

Demiate, I.M., Oetterer,M., Wosiacki,G.,2001.Characterization of chestnut (*Castanea sativa*) starch for industrial utilization. Brazilian Archieves Biololgy and Technology 44,69-78.

Dorman H.J.D., Peltoketo Hiltunen R., Tikkanen M.J. 2003. Characterization of antioxidant properties of de-odourised aqueous extracts from selected lamiaceae herbs. *Food Chemistry* 83:255-262.

Ertürk,Ü., Mert,C., Soylu, A. 2006. Chemical composition of fruits of some important chestnut cultivars. Brazilian Archives of Biology and Technology 49(2),183-188.

Ferreria-Cardoso, J.V., Fontainhas-Fernandes,A.A., Torres-Pereira,M.G. 1993. Nutritive value and technological characteristics of *Castanea sativa* Mill. fruits-comparative study of some Northeastern Portugal cultivars. In: International Congress on Chestnut, Spoleto, Proceedings. Spoleto, Italy.

Jaynes, R.A. 1979. *Chestnuts nut tree Culture in North America*. (ed R.A.Jaynes),In: Proceedings of the 70 th Annual Report of the Northern Nut Growers Association, Inc.

Macrae, R., Robinson, R.K. Sadler, M.J. (eds.) 1993. Encyclopaedia of Food Science, *Food Technology and Nutrition, Vol. 5*, 3126-3131, Academic Press INC., San Diego,CA.

Püskülcü, H. & Ikiz, F. 1989. Introdiction to Statistic. Bilgehan Presss, p 333, Bornova,Izmir, Turkey.(in Turkish)

Ross, F. A. 1959. Dinitrophenol methods for reducing sugars. *Potato Processing,* In: Talburt, W. F. And Smith, O. (Eds.). A VI Publishing Comp. Connecticut. pp. 469-470.

Skujins, S., 1998. *Handbook for ICP-AES (Varian-Vista)*. A short Guide To Vista Series ICP-AES Operation. Varian Int. AG, Zug, Version 1.0, Switzerland

Üstün,N., Tosun,Y., Serdar,Ü.1999. Technological properties of chestnut varieties grown in Erfelek district of Sinop city. Acta Horticulture 494,107-110.

J.C.M. Barreira, I.C.F.R. Ferreira, M.B.P.P. Oliveira, J.A. Pereira, Antioxidant activities of the extracts from chestnut flower, leaf, skins and fruit, *Food Chem. 107* (2008) 1106–1113.

V.L. Singleton, J.A. Rossi, Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents, *Am. J. Enol. Vitic. 16* (1965) 144–158.

Table 1. Chemical properties of some chestnut fruits (n:3)

Properties	Locations		
	Aydın	Bursa	Kastamonu
Moisture (%)	56.9±1.3*a	52.6±2.8b**	51.7±3.1b
Crude protein (%)	6.3±1.1a	4.4±1.7b	5.1±1.9b
Crude fibre (%)	2.3±0.47c	3.7±0.98a	2.8±0.63b
Crude oil (%)	2.8±0.87b	3.5±0.69a	2.2±0.89c
Ash (%)	2.1±0.59b	2.3±0.76b	2.7±0.49a
Total carbohydrate (%)	81.3±3.8a	78.4±3.8b	73.2±2.6c
Total phonel (g GAE/100 g extract)	24.7±2.8a	23.5±3.6b	21.8±1.9c
Ca (mg/kg)	2090±12.8b	1967±11.7b	2710±14.3a
Mg (mg/kg)	1713±4.8a	1476±6.2b	1216±3.8c
Na (mg/kg)	418±1.17a	297±2.56b	319±1.98b
K (mg/kg)	10719±32.8c	14867±27.6a	12375±23.7b
P (mg/kg)	1627±12.1b	1849±16.4a	1764±15.9a
Zn (mg/kg)	47±1.6c	64±2.3b	79±1.4a

*mean±standard deviation

**Means within colomns bearing th same letters supercripts are not significantly different.