İstanbul Ecz. Fak. Mec.
34 (1) (2001)

J. Fac. Pharm. Istanbul
34(1) (2001)

THE CHANGES IN SOME CONSTITUENTS OF FOŞA VARIETY HAZELNUTS (*Corylus maxima Miller*) BY THE YEAR

F.G. KIRBAŞLAR*, H. ORAK*, and T. GÜRCAN**

SUMMARY

In this study, foşa variety hazelnuts (*Corylus maxima Miller*) from Trabzon area (Turkey) of six consecutive years (1994-1999) were used. In hazelnuts content of moisture, oil, protein, total sugar, starch, crude fiber, and ash were determined for each year. The fatty acids composition and some physicochemical properties of extracted oil from the hazelnut samples were also determined. The differences in the analysed constituents were tested by the ANOVA statistical test.

ÖZET

Bu çalışmada Trabzon ilinin Araklı ilçesine bağlı Yeşilce köyünden 1994-1999 yılları arasında olmak üzere, birbirini izleyen 6 yıl süre ile toplanan foşa çeşidi fındık örnekleri kullanılmıştır. Fındık örneklerinin türü *Corylus maxima Miller* dir. Her yıl toplanan örneklerin nem, yağ, protein, toplam şeker, nişasta, ham lif ve kül içerikleri

* Istanbul University, Facltuy of Engineering, Department of Chemistry, 34850, Avcılar
** TÜBİTAK Marmara Research Center, Food Science and Technology Research Institute, Gebze, Turkey.

incelenmiştir. Örneklerden özütlenen yağların Gaz Kromatografisi yöntemi ile yağ asidi bileşimleri belirlenmiş ve fiziksel-kimyasal özellikleri incelenmiştir. 6 yıl süre ile incelenen fındık örneklerinin yıllara göre yağ asidi bileşimleri ve diğer bileşenlerindeki değişimler araştırılmış, değişimlerin anlamlılığı ANOVA istatistiksel testleri ile değerlendirilmiştir.

Anahtar Kelimeler: Hazelnut, Hazelnut oil, Fatty acid

INTRODUCTION

Turkey is the most important producer of hazelnuts in the world. Black Sea Region is main area of hazelnut cultivation, which represents about 97 % of the total production of Turkey [1, 2]. The quality of the hazelnut varieties was based on its physical characteristics and its content of nutrients. In this respect the oil content and its fatty acids composition has the main role on the hazelnut quality. The percentage of unsaturated fatty acids is normally maintained in the 91.0-92.5 % range based on average values of the different varieties, and in the 7.4-8.9 % range for saturated fatty acids [3-7]. The percentage of oil, its stability and composition of fatty acids were found to depend on the variety, geographical conditions, climate and growth conditions and harvest conditions [7-11]. The second important nutrient of hazelnut is protein with in the levels of 12-16 % [8, 11,12]. The climate and composition of soil in the Black Sea Region is very variable. So that there are many variety which predominant in the same places.

Table 1 : Chemical composition of hazelnut samples (%)

Component	1994		1995		1996		1997		1998		1999	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Moisture	6.11	0.04	5.43	0.05	4.49	0.02	4.45	0.02	3.63	0.03	5.97	0.02
Oil	62.94	0.11	62.94	0.12	63.47	0.23	63.65	0.24	64.56	0.18	62.90	0.27
Protein	15.98	0.09	16.32	0.08	16.62	0.04	16.52	0.04	16.71	0.05	15.86	0.03
Total sugar	6.15	0.18	6.53	0.15	6.60	0.22	6.75	0.29	6.83	0.24	6.56	0.18
Starch	2.70	0.08	2.72	0.06	2.78	0.10	2.77	0.08	2.85	0.07	2.72	0.12
Crude fiber	2.67	0.06	2.69	0.07	2.70	0.08	2.65	0.05	2.77	0.06	2.69	0.05
Ash	2.57	0.02	2.52	0.02	2.58	0.01	2.55	0.02	2.58	0.02	2.56	0.02

$\overline{X}$: mean, SD: standard deviation

The purpose of this study is to determine whether there are significant differences in the hazelnuts foşa (*Corylus maxima Miller*) varieties in respect to moisture, oil, fatty acids, protein, total sugar, starch, crude fiber, and ash for six consecutive harvesting years.

RESULT AND DISCUSSION

The values of moisture, oil, protein, total sugar, starch, crude fiber and ash of hazelnuts samples and statistical values of these constituents are presented in Table 1 and Table 2 respectively. Moisture contents of hazelnuts are ranged between 3.63-6.11 %. It was found that the samples of six consecutive harvesting years have the lowest moisture in 1998 and the highest in 1994 year. The differences between the moisture content among the years are significant (P=0.01). Parcerisa et al. Were found significant differences in moisture content between years [9]. The oil, protein and ash contents were determined to ranged between 62.94 - 64.58 %, 15.86 -16.72 %, 2.52-2.58 % respectively. The differences in that values among the hazelnuts of six consecutive years are not significant (p>0.05). The oil, protein and ash content are found to be higher than the those found for this variety of hazelnut [8].

Table 2 : Values of statistical analyses

Component	$\overline{X}$	SD	P	Literature values
Moisture	5.01	0.03	0.01	3.02-4.90 [2, 8]
Oil	63.42	0.19	0.10	62.80-67.60 [6, 8]
Protein	16.34	0.06	0.06	16.45-19.63 [2, 8]
Total sugar	6.57	0.21	0.11	4.80-8.33 [17, 18]
Starch	2.76	0.09	0.18	1.00-2.68 [17, 18]
Crude fiber	2.70	0.06	0.15	1.70-3.98 [17, 18]
Ash	2.56	0.02	0.15	2.16-2.80 [2, 8]

$\overline{X}$: mean, SD: standard deviation, p: significance level, confidence limits (α=0.05).

The main sugar found in the hazelnuts was sucrose while fructose, glucose, myo-inositol and raffinose were found in trace [18]. So that the total sugar value is mainly consisted of the sucrose. In the hazelnut samples, total sugar, starch and crude fiber were found to be between 6.15-6.83 %, 2.70-2.85 % and 2.65-2.77 % respectively. The differences in these constituents among the year are not found to be significant (p>0.05).

Fatty acids composition of hazelnut samples were summarised in Table 3. The mean oleic acid of hazelnut samples was found to be 81.03 %. Oleic acid content ranged

Table 3 : Fatty acid composition of hazelnut oils

Year	Oil (%)	Fatty acid composition (%)							
		$C_{16:0}$		$C_{18:0}$		$C_{18:1}$		$C_{18:2}$	
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
1994	62.94	4.35	0.07	1.10	0.09	80.75	1.20	13.80	0.14
1995	62.94	4.55	0.09	1.40	0.14	81.45	0.16	12.60	0.18
1996	63.47	5.91	0.07	2.18	0.15	80.31	0.25	11.68	0.32
1997	63.65	5.67	0.05	1.88	0.11	80.89	1.08	11.56	0.19
1998	64.58	5.19	0.07	2.29	0.16	84.27	0.32	8.26	0.29
1999	62.96	5.18	0.06	1.75	0.10	78.49	0.18	14.57	0.31
Mean	63.42	5.14	0.07	1.77	0.13	81.03	0.53	12.08	0.24
P	0.10	0.08		0.05		0.02		0.04	
Literature values [6,8]	62.80-67.60	5.10-6.70		1.60-2.60		71.40-83.70		6.80-20.10	

$\overline{X}$: mean, SD: standard deviation, p: significance level, confidence limits (a=0.05).

from 78.49 to 84.27 %. The lowest and the highest oleic acid were determined in the 1999 and 1998 year's respectively. The differences in the oleic acid content are found to be significant (p=0.02). The second major acid in hazelnut oil was linoleic acid. This acid was found to be ranging from 8.26 to 14.57 % in the hazelnut samples of six consecutive year. The lowest and the highest level were belonged to 1998 and 1999 years hazelnut samples respectively. The changes in levels of linoleic acid was significant (p=0.04). Parcerisa et al. also found significant differences in the unsaturated fatty acids between years [9]. The sums of the unsaturated acids were ranging from 91.99 to 94.55 %. This values were slightly higher than those in literature [11]. Linoleic acid content of the hazelnut samples found in this study was lower than the content found by Baş et al.[8]. The lower value of linoleic acid in the hazelnut oil indicates that the hazelnuts can be stored for a long period without lowering the quality [3, 17]. Saturated fatty acids palmitic and stearic acids are determined to be ranging from 4.35 to 5.91 % and from 1.1

Table 4 : Physicochemical properties of hazelnut oils

Year	Refractive index (20°C)	Density (20°C)	Peroxide value (meq/kg)	Acid Value (%oleic acid)	Iodine number	Saponification value
1994	1.4610	0.9017	2.5	0.3	90	185
1995	1.4610	0.8998	2.5	0.2	90	185
1996	1.4615	0.9015	2.5	0.2	89	184
1997	1.4610	0.9010	2.5	0.2	89	185
1998	1.4610	0.9010	2.4	0.2	89	184
1999	1.4615	0.9012	2.6	0.3	90	185
Mean	1.4612	0.9010	2.5	0.23	89.5	184.7
P	1.51	1.12	1.87	1.21	1.32	1.85
Literature values[11]	1.4676 (25 °C)	0.9144	3.0	0.3-0.9	85-98	187-192

p: significance level, confidence limits (α=0.05).

to 2.29 % respectively. Changes in the levels of these acids among the six year were not found to be significant ($p>0.05$). Palmitic and stearic acids levels found in this study were lower than the literature data [5, 6].

The levels of refractive index, density, iodine number, acid value, peroxide value, and saponification value of hazelnut oils were summarised in Table 4. In this study, refractive index, density, iodine number, acid value, peroxide value, and saponification values were found to be 1.4612, 0.9010, 0.23, 89.5, 184.7 and 2.5 respectively. The differences in the physicochemical properties of the hazelnut oils among the six year were not significant. The levels of refractive index, density, iodine number, acid value, peroxide value, and saponification value were slightly lower than that found in the literature [11].

According to the mean results of oil content and fatty acids composition the quality of foşa variety hazelnuts is found that better than before found in literature for this variety. No important differences in composition of hazelnuts harvested at six consecutive years were found. The significant differences that occurred in the some parameters

may be due to the differences in the fall regime and a little changes occurred in the farming practise from year to year.

EXPERIMENTAL

Material

In this study foşa variety hazelnuts (*Corylus maxima Miller)* of six consecutive harvesting years (1994-1999) which were produced in the Trabzon area were used. The hazelnuts collected every year from the trees at the beginning of September. Naturally dried samples were stored at 40°C and 60-65 % relative humidity with the shell. Analyses were performed on the powder prepared from the deshelled hazelnut, grinding in a blender and sieved with a 0.5 mm hole sieve. All analyses were carried out in triplicate.

Method

Moisture content: Moisture content was determined by weight loss after heating in an oven at 105 °C and 100 mmHg [13].

Extraction of Oil: Oils were extracted in a Soxhlet extractors with petroleum ether (40-60°C) [13].

Fatty acid composition: Fatty acid methyl esters were prepared from hazelnut oil using BF_3/CH_3OH as methylating reagent [14]. Methyl esters were analysed by a Philips Pye Unicam PU 4500 model Gas Chromatograph equiped with a FID detector and SP 2340 capillary column. Injector, column and detector temperatures are 220 °C; 200 °C and 245 °C respectively. Carrier gas (He) flow rate was 1.5 mL/min. All determinations were performed on a SP 4290 Spectra-Physics integrator.

Physicochemical properties of oil: Determinations of refractive index, density, iodine number (by the Hanus Method), acid value, peroxide value, saponification value, were all carried out following Anon method [13].

Protein content: Nitrogen in seed cakes was determined according to the Kjeldahl Method, and the percentage of protein was calculated using the factor 6.25 [13].

Total sugar content: The soluble sugars in the samples were extracted with 70 % ethyl alcohol. The total sugar (reducing and non-reducing sugars) were determined in the extract by gravimetric method [13].

Starch content: Starch was determined gravimetricaly from the alcohol-insoluble residue hidrolysate [13].

Crude fiber content: Determination of crude fiber was performed with the methods described by Bellucci [16].

Ash content: Ash content was determined by overnight heating at 550 °C [13].

Statistical Analysis: Experimental results was performed by a one-way analysis of variance calculation (ANOVA).

REFERENCES

1. Davis, P.H., Flora Of Turkey and the East Aegean Islands, Vol. 7, p. 682-684 University Press, Edinburgh, (1982).
2. Ayfer, M., Uzun, A. ve Baş, F.C., Türk Fındık Çeşitleri, s. 6-21 Karadeniz Bölgesi Fındık İhracatçıları Birliği, Giresun, (1986).
3. Zürcher, K. und Hadorn, H., *Mitt. Gebiete Lebensm. Hyg.*, **66,** 191-224 (1975).
4. Yazıcıoğlu, T. and Karaali, A., *Fette Seifen Anstrıchmittel,* **85,** 1, 23-30 (1983).
5. Garcia, J.M., Ağar, İ.T. and Streif, J., *Tr. J. of Agricultural And Forestery*, **18**, 199-202 (1994).
6. Bonvehi, S.J. and Coll, V.F., *Food Chem.*, **48**, 237-241 (1993).
7. Hadorn, H., Keme, T., Kleinert, J., Messerli, M., and Zurcher, K., *Rev. Choc. Confectionary Bakery*, **2,** 16-39 (1977).
8. Baş, F.,Ömeroğlu, S., Türdü,S. ve Aktaş, S., *Gıda,* **11**, 4, 195-203 (1986).
9. Parcerisa, J., Boatella, J., Codony, R., Farran; A:, Garcia, J., Lopez; A., Rafecas, M., and Rumero, A., *Food Chem.*, **48,** 411- 414 (1993).
10. Parcerisa, J., Boatella, J., Codony; R., Rafecas, M., Castellote, A.I., Garcica, J., Lopez, A. and Romero, A., *J. Agric. Food Chem.*, **43,**1, 13-16 (1995).
11. Belitz, H.D. and Grosch, W., Food Chemistry, Translation From The Second German Edition By D. Hadziyev, Springer-Verlag-Berlin-Heidelberg Printed By Germany (1987).
12. Pala, M., Açkurt, F., Löker, M., Yıldız, M., Ömeroğlu, S., *Tr. J. of Agriculture and Foresty* **20,** 43-48 (1996).
13. Anon, Official Methods Of Analysis, 15th Ed. Association of Official Analytical Chemists (AOAC), Kenneth Herrich (Ed.) Arlington, Virginia 22201 USA (1990).
14. Slover, H. T. and Lanza, E., *J. Am. Oil Chem. Soc.* **56,** 933-943 (1979).
15. Anon. Iupac. Standard Methods for Analysis of Oils. Fats and Derivatives. 6 Th Ed. Paquot. Co. Pergamon Press. (1979).

16. Kozcaz, M. and Keskin, H., *Chim. Acta Turc.* **14,** 251-264 (1986).

17. Zürcher, K. und Hadorn, H., *Mitt. Gebiete Lebensm. Hyg.* **67,** 170-191 (1976).

18. Bonvehi, J.S. and Coll, F.V., *Food Chem.*, **46,** 285-288 (1993).