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The physico-chemical properties and fatty acid composition of three different hazelnut varieties collected at the different harvest periods

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Abstract

The oil contents of hazelnut samples were found low at the first harvest periods. The oil contents of the first harvest period ranged from 12.3% to 6.51%. The moisture contents of nuts were found low in the same period. The oil contents of hazelnuts harvested at the last harvest period were ranged between 53.40% (sharp) to 66.11 (black). In general, palmitic, stearic, oleic, linoleic acid were identified as dominant fatty acids. Depending on the cultivar and harvest, the oleic acid have been identified at the highest rate and have been partial differences among the varieties. The oleic acid contents of varieties were determined between 74.79% to 85.58% depending on harvest period. Linoleic acid content was ranged from 5.70 to 15.64 %, palmitic acid content ranged from 4.92% to 7.31%. As other fatty acids was found at the minor level. The highest palmitic, oleic and linoleic acid contents have been identified respectively in Tombul (II.harvest), Black (II.harvest) and Tombul (I.harvest) varieties. The optimum harvesting time as depending on the physico-chemical properties of the all hazelnut varieties is understood to be August and September months.

Keywords: hazelnut, varieties, harvest periods, proximate, fatty acid composition

1. Introduction

Hazelnut tree, *Corylus avellana* L., is distributed widely in North of Turkey. It is a shrub or tree from Betulaceac family, Corylaceae family and Corylus genus [1]. Hazelnut is among the first species which migrated to northern Europe in the ice age in 17 to 18 thousand BC In seven thousand and five hundred years to eight thousand BC hazelnut had a wide habitat in Europe. However, its habitat has been decreased since 5500 BC due to human activities. The oldest existing knowledge on hazelnuts dates back to the year 2838 BC [2]. There are certain botanical differences between various hazelnut species. There is a huge genetic diversity in hazelnut and most of the existing cultivars are the results of natural selection by human [3,4]. There are several cultivars with various botanical features and different economical values. It is, therefore, important to determine their nutritional properties, and to establish their lipids to find out if the results agree with those reported in literature for hazelnut of other origins [6-10]. Turkey is the main hazelnut producer in the world. Nuts fat is mostly unsaturated, and unsaturated fatty acids have been associated with beneficial effects. Among the nuts, hazelnut has an important role in human nutrition and health, because of its special fatty acid composition, which includes oleic and linoleic acids as well as the

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presence of tocopherols and sterols. Also, it provides an excellent source of energy due to its high oil content of approximately 60% [6,8,10-12]. In addition, it is rich in protein and oil [6,11]. Plant seed and kernels are important sources of oils of nutritional, industrial, and pharmaceutical importance. This necettitates the search for new sources of novel oils. Recently, a great deal of attention has been given to the hazelnut and their oil, and their consumption has thus increased, especially in Europe countries. More detailed research focusing on the nutritional quality and health-promoting component of hazelnuts will enhance our knowledge and encourage hazelnut consumption. In this study, hazelnuts growing in middle Anatolia were used firstly. The aim of this study was to investigate the chemical properties of hazelnuts collected at the different harvest periods from several regions of Turkey.

2. Materials and Method

2.1.Material

Hazelnut varieties (Kara, Tombul and Sivri) were collected by hand in different harvet periods in Giresun, Turkey in 2012. Fruits were cleaned in an air condition, and then stored in polypropylene bags at room temperature. Each sample was analysed as the whole nut, without the shell.

2.2. Method

2.2.1.Oil content

The oil content was determined according to the method ISO 659:1998 (ISO,1998). About 2 g of the kernels were ground in a ball mill and extracted with petroleum ether in a Twisselmann apparatus for 6 h. The solvent was removed by a rotary evaporator at 40 °C and 25 Torr. The oil was dried by a stream of nitrogen and stored at –20 °C until used. Physical and chemical properties of hazelnut fruits were analysed according to Özdemir et al. [13].

2.2.2. Determination of Fatty acids

Fatty acid compositions for hazelnut seed oil were determined using a modified fatty acid methyl ester method as described by Hışıl [14]. The oil was extracted three times for 2 g air-dried seed sample by homogenization with petroleum ether. The oil samples (50-100 mg) was converted to its fatty acid methyl esters (FAME). The methyl esters of the fatty acids (1 µl) were analysed in a gas chromotography (HP 6890) equipped with a flame ionising detector (FID), a fused silica capillary column (60 m x 0.25 mm i.d.; film thickness 0.20 mikrometere). It was operated under the following conditions: oven temperature program. 175 ^{o}C for 7 min. Raised to 250 ^{o}C at a rate 5 ^{o}C/min and than kept at 250 ^{o}C for 15 min); injector and detector temperatures, 250 and 250 ^{o}C; respectively, carrier gas. nitrogen at flow rate of 1.51 ml/min; split ratio. 1/50 µl/min.

2.2.3.Statistical analyses

Results of the research were analysed for statistical significance by analysis of variance [15].

3. Results and Discussion

Some physical and chemical properties of Sivri, Tombul and Kara hazelnut varieties collected at different maturation stages were given in Table 1. The ash and protein contents of hazelnuts have not been a significant change by the time of harvest. The oil contents of hazelnuts were found very low at the first harvest period. The oil contents of this period ranged from 30.31% to 32.17%. The moisture contents of hazelnuts were found low in the same period. The protein contents of sharp kind hazelnuts were found higher than the others all the harvest period. The oil contents of hazelnuts were found between 53.40% (sivri) to 66.11 (kara) in the last harvest period. Consequently, depending on the maturation of hazelnuts weren't important change in protein and ash content, increased oil content. The optimum harvesting time as depending on the physico-chemical properties the all hazelnut varieties is understood to be August and September month. Any sample had not contained trans fatty acid.

Fatty acid composition of oil of several hazelnut varieties harvested at different periods are presented in Table 2. The first harvest period is July month that has been harvested two times in this period, one times as in August and September months. In general, the dominant fatty acids have been identified palmitic, stearic, oleic, linoleic acid. Depending on the cultivar and harvest, the oleic acid have been identified the highest rate and have been partial differences among the varieties. The oleic acid contents of varieties were determined between

74.79% and 85.52% depending on harvest period. Linoleic acid content ranged from 5.70 to 15.64 %, palmitic acid content was ranged from 4.92% to 6.50%. As other fatty acids was found to be minor level. The highest palmitic, oleic and linoleic acid contents have been identified respectively in Kara (31J) and Tombul (31J) varieties. As stearic acid content of hazelnut oils was 3.03% (Tombul, 31J). Content of saturated fatty acids in nuts (SAFA) changed between 7.28% to 9.41%, as monounsaturated fatty acids (MUFA) content changed between 74.91% to 85.63%. There wasn't found trans fatty acid content any harvest period and in variety. The omega-6 fatty acid content of varieties were determined high rate rather according to omega-3 fatty acid content. The omega-6 fatty acids content of varieties changed between 5.70% to 15.64%. As a result, the progress of ripening has been a minor level reduction oleic acid in varieties. Therefore, fatty acids were shown variability depending on the varieties and harvest time. In the three studied cultivars (Daivana), Total ash contents of hazelnuts were found between 1.87-2.72 % [17]. Some differences can be noticed, probably due to the different location of the orchard from where the samples were collected, as well as to the year of harvest. According to this fact, there are evidences that harvesting year and archard location can influence the chemical composition of hazelnuts [8].

Hazelnut kernels are a good souree of fat (50-73%) and contain unsaturated fatty acids (linoleic, linolenic, oleic, palmitic and stearic acids), essential for human health [16]. The mosture content of hazelnut cultivars charged betwenn 2.49 % (Black hazelnut) to 5.25% (Cavcava) [17]. The oil contents of hazelnut varieties was above 50% and 68.52% [17]. Due to the high ratio of unsaturated / saturated fatty acids established in hazelnut kerrels, its addition to processed food can improve the nutritional quality of the manufactured food [18,19]. Crude proein contents of hazelnut kerrels rarged from 11,7% to 20,8% [17]. Most predominate in the oil of hazelnuts is oleic acid, with amounts between 76.3 % (Doğanhisar-Tekke) and 82.6 % (Deutsche), with a mean value of 79.6 % fort he five different samples. In nut oils collected in Konya (Beybes-Konya) and Konya (Doğanhisar) was more than 76 % of oleic acid found in the oil [20]. As another quantitatively interesting unsaturated fatty acid, the oil contained linoleic acid in a range from 6.5 to 14.0 %, with a mean value of 10.02 %. In the case of linoleic acid, the variation was smaller. In all the other hazelnut oils, the amount of linoleic acid was significantly lower. Nutritionally unfavorable is the high content of saturated fatty acids, consisting of palmitic acid, which amounted to between 5.7 % (Doğanhisar-Tekke) and 6.5 % (Beybes-Konya), with a mean value of 6.08 % and stearic acid, which was found in a very small range between 2.1% (Giresun) and 3.8 % (Beybes-Konya), with a mean value of 2.8 % [20]. Savage et al. [11] established 4.08-5.94% palmitic, 73.80-80.07% oleic, 11.96-16.53% linolenic and 1.62-2.03% stearic acids in hazelnut cultivar oils grown in New Zealand. Özdemir et al. [9] reported that some commercial and new hybrid hazelnut kernel oils contained 6.6-8.3% palmitic, 1.8-3.8% steraic, 75.7 – 80.7% oleic and 10.1-13.8 linoleic acids. The main fatty acids of different hazelnut oils in Turkey were 6.38% palmitic, 1.68% stearic, 76.78% oleic and 14.75% linoleic acids [6]. Parcerisa et al. [8] reported that oleic acid was dominant in hazelnut oil. These are comparable to data previously reported in the literature within the limits of the slightly different analytical methods used around the world, the composition of hazelnut oil is uniform.

Köksal et al. [17] established 4.72% to 5.87% palmitic, 0.86% to 2.49% stearic, 74.2% to 82.8% oleic and 9.82% to 18.7% linoleic acids in several hazelnut (*Corylus avellana* L.) varieties. Due to the high ratio of unsaturated /saturated fatty acids found in hazelnut, its addition to processed food can improve the nutritional quality of the manufactured food [7,17,18]. The fatty acid composition of hazelnut oil was similar to that reported previously [6,9-11]. In addition, the highest concentratin of oleic and linoleic acid in hazelnut kernels allows oxidative rancidity to ocur. As a result, hazelnut is a good herticulture product, depending on human nutrition and beneficial nutrient composition. So, growing conditions, hervest time, storge and processing can affect the nutritional volue of hazelnut varieties.

Table 1. Some physico-chemical properties of three hazelnt cultivars

Harvest periods		Dry matter (%)	Crude ash (%)	Crude oil (%)	Crude protein%)**
July	Tombul	75.09±1.78*	1.55	31.70±1.40	12.07±1.05
	Sivri	68.59±2.34	1.81	30.31±2.10	13.58±1.31
	Kara	75.37±2.90	1.67	32.17±2.07	9.99±1.56
August	Tombul	88.02±1.97	1.74	55.14±1.67	12.46±1.43
	Sivri	81.60±1.67	1.59	58.92±3.78	13.59±1.29
	Kara	78.09±2.71	1.53	51.48±2.34	10.03±0.98
September	Tombul	84.92±2.78	1.69	61.49±2.89	12.15±1.56
	Sivri	94.58±2.54	1.76	53.40±1.78	15.29±1.29
	Kara	94.85±3.42	1.66	66.11±2.86	11.58±1.73

*mean±standard deviation; **Nx6.25

Table 2. Fatty acid composition of oil of several hazelnut varieties harvested at different periods

Yağ Asitleri (%)	11J* S	11J T	11J K	31J S	31J T	31J K	20A* S	20A T	20A K	9SP* S	09SP T	9SP K
C8:0	-*	-	-	0.05	0.06	0.06	0.03	-	-	-	-	-
C10:0	-	-	-	0.24	0.03	-	-	-	-	-	-	-
C12:0	-	-	-	0.02	-	-	0.00	-	-	-	-	-
C14:0	0.02	0.16	-	0.04	0.07	0.01	0.03	0.06	0.02	-	0.01	0.02
C16:0	4.95	5.29	4.92	6.14	6.50	5.55	5.55	5.54	5.59	5.03	5.35	5.23
C16:1	0.12	0.12	0.11	0.06	0.15	0.12	0.11	0.16	0.12	0.10	0.11	0.11
C17:1	-	-	-	-	0.04	-	0.03	-	-	-	-	-
C18:0	2.56	2.64	2.36	2.93	3.03	2.85	2.78	2.26	2.68	2.38	2.57	2.27
C18:1CIS	82.79	74.79	85.39	83.01	81.36	85.52	82.98	80.21	84.50	85.22	85.23	84.70
C18:2CIS	8.64	15.64	7.09	7.52	8.49	5.70	8.24	11.43	6.88	7.14	6.50	7.49
C18:3CIS	0.82	1.19	0.12	-	0.15	0.14	0.15	0.23	0.13	0.14	0.13	0.16
C20:0	0.10	0.16	-	-	0.15	0.06	0.11	0.10	0.10	-	0.06	0.05
TOPLAM	100.0	99.9	99.9	100.00	100.00	100.00	99.95	99.99	100.0	100.0	100.0	100,0
SAFA	7.63	8.25	7.28	9.41	9.82	8.53	8.50	7.96	8.38	7.41	7.99	7.57
MUFA	82.91	74.91	85.50	83.01	81.55	85.63	83.12	80.37	84.62	85.32	85.40	84.80
PUFA	9.46	16.83	7.21	7.52	8.64	5.84	8.39	11.67	7.00	7.28	6.63	7.64
TRANS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ω 3	0.82	1.19	0.12	0.00	0.00	0.14	0.15	0.23	0.13	0.14	0.13	0.16
Ω 6	8.64	15.64	7.09	7.52	8.49	5.70	8.24	11.43	6.88	7.14	6.50	7.49
MUFA+PUFA	92.37	91.74	92.71	90.60	90.18	91.47	91.50	92.04	91.62	92.60	92.01	92.44

*nonidentified; **J: July, A: August, SP: September;; S:sivri, T:tonbul, K:kara

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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.

References

1. Erdogan V, Shawn AM, Distribution of quantitative traits in hazelnut progenies. *Acta Hort*. **2000**, *790*, 143-161.
2. Darabzand S, Hazelnut role in the economy and protecting forests. *Journal of Range Forest. Forest and Range Organization of Iran*. No. 48 Page 44, (2000).
3. Lagersted HB, Filbert. pp. 456-489. In: J. Janick and J. N. Moore (eds.) *Advances in fruit breeding*. Purdue University Press. West Lafayette, Indiana, USA, (1975).
4. Mehlenbacher SA, Hazelnut (*Corylus avellena* L.). Pp. 791-836. In: J. N., Moore and J. R. Ballington (eds.) Genetic resources of temperate fruit and nut crops. Wageningen Press, (1991),The Netherlands.
5. Allam SSH, Utilization of some untraditional sources of high oleic acid oils for improving vegetable oils stability. La Rivista Italiana Delle Sostanze Grasse **2001**, *LXXVIII*, 337-341.
6. Baş F, Ömeroğlu S, Türdü S, Aktaş S, Composition of the main hazelnut varieties cultivated in Turkey. *Food Chem*. **1986**, *11*(4), 195-203.
7. Bonvehi JS, Coll FCV, Oil content, stability and fatty acid composition of the main varieties of Catalonian hazelnuts (*Corylus avellana*L.). *Food Chem*. **1993**, *48*, 237-241.
8. Parcerisa J, Boatella J, Codony R, Farran A, Garcia J, Lopez A, Rafecas M, Romero A, Influence of variety and geographical origin on the lipid fraction of hazelnuts (*Corylus avellana* L.) from Spain: I.Fatty Acid Composition. *Food Chem*. **1993**, *48*, 411-414.
9. Özdemir M, Açkurt F, Kaplan M, Yıldız M, Löker M, Gürcan T, Biringen G, Okay A, Seyhan FG, Evaluation of new Turkish hybrid hazelnut (*Corylus avellana* L.) varieties: fatty acid composition, α-tocopherol content, mineral composition and stability. *Food Chem*. **2001**, *73*, 411-415.
10. Alasalvar C, Shahidi F, Ohshima T, Wanasundara U, Yurttaş HC, Chandrika ML, Rodrigues FB. Turkish tombul hazelnut (*Corylus avellana* L.). Lipid characteristics and oxidative stability. *Journal od Agricultural and Food Chem* **2003**, *51*, 3797-3805.
11. Savage G P, McNeil DL, Dutta PC. Lipid composition and oxidative stability of oils in hazelnuts (*Corylus avellana* L.) grown in New Zealand. *Journal of American Oil Chemistry Society* **1997**, *74*, 755-759.
12. I.Oliveira, A. Sousa, J.S. Morais,I.C.F.R. Ferreira, A. Bento, L. Estevinho, J.A. Perreira, Chemical composition and antioxidant and antimicrobial activities of three hazelnut (*Corylus avellana* L.) cultivars. *Food Chem*. **2008**, *46*, 1801-1807.
13. Özdemir M, Topuz A, Doğan U, Karkacier M. Fındık çeşitlerinin bazı fiziksel ve kimyasal özellikleri. *Gıda* **1998**, *23*, 37-41.
14. Hişil Y, *Instrumental Analysis Techniques* (Eng Fac Publ 55), (1998), Ege Üniversity,
15. Bornova -İzmir. (in Turkish). Püskülcü H, İkiz F, *Introduction to Statistic*. Bilgehan Press. p333., (1989), Bornova. İzmir,Turkey,. (in Turkish)
16. Garcia JM, Ağar IT, Streif J, Lipid characteristics of kernels from different hazelnut varieties. *Turk.J. Agric. Forest*. **1994**, *18*, 199-202.
17. Köksal AI, Artık N, Şimşek A, Güneş N, Nutrient composition of hazelnut (*Corylus avellana* L.) varieties cultivated in Turkey. *Food Chem*. **2006**, *99*, 509-515.
18. Ebrahem KS, Richardson DG, Tetley RM, Mehlenbacher SA, Oil content, fatty acid composition, and vitamin E concentration of 17 hazelnut varieties, compared to other types of nuts and oil seeds. *Acta Hort.* **1994**, *351*, 685-692.
19. Matthaus B, Özcan MM, The comparison of properties of the oil and kernels of various hazelnuts from Germany and Turkey. *Eur. J. Lipid Sci. Technol*. **2012**, *114*(7), 801-806