

FATTY ACID COMPOSITION OF PISTACHIO NUTS IN TURKEY*

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In this study oil yields and fatty acid compositions in the kernels of two varieties (Uzun and Siirt) of pistachio grown in different region of Turkey were investigated. Kernel oils were obtained by Soxhlet extraction using petroleum ether. The yields were found to be 57.1–58.9% and 56.1–62.6 respectively for the Uzun and Siirt varieties, on a moisture-free basis. Fatty acid composition of oils were analysed by GC/MS in the methyl ester form. Fourteen fatty acid components representing about 99% of the total oils were characterised. Oleic acid (55.4–62.6% and 60.7–65.5%, respectively) was the main fatty acid component in both varieties. Pentadecanoic acid, (Z)-7-hexadecenoic acid, margaric acid, Z-7-octadecenoic acid, arachidic acid, 11-eicosenoic acid, and behenic acid were detected in both varieties for the first time.

Key words: *Pistacia vera* L., kernel oil, fatty acid, oleic acid.

Turkey is the third largest biggest country in the world engaged in the pistachio trade [1]. The majority of pistachio trees (*Pistacia vera* L.) are grown in the Southeastern region of Turkey. Grafted pistachio on wild *Pistacia* species are also grown in different regions of Turkey [2]. The production of pistachio nuts in Turkey has increased in recent years. When about 1.7 million hectares in Southeastern Anatolia are irrigated soon by the GAP (Southeastern Anatolia Project), the pistachio production potential of Turkey is estimated to increase 2–3 times [3].

Uzun and Siirt are the main pistachio varieties in Turkey. Turkish pistachios are preferred by many European and USA markets due to their distinct flavor and uniform green kernels.

According to the data obtained from DIE (State Statistics Institute-Turkey), the export of pistachio nuts in Turkey has increased to 300000 tons in recent years [4].

The oil content of pistachio nut is generally more than 55% [5–7]. The oil contains linoleic and linolenic acids that are essential in human diet. Moreover, these fatty acids have been shown to reduce the level of cholesterol in blood. They prevent cardiovascular diseases better than any other oil [7, 8]. Furthermore, pistachio nut oil is also used in cosmetic and pharmaceutical industries [9].

Although the kernel oil compositions of Turkish pistachios in Southeastern Anatolia have previously been studied [7, 10–13], there is no report on the oil yield and compositions of pistachios in Northwestern and Aegean regions in Turkey. The pistachio nuts with green colored kernels in this region are used in confectionary industry.

Here, we report on the fatty acid compositions of Uzun and Siirt varieties from Gaziantep, Manisa, and Ayvacik regions.

Moisture contents and oil yields of pistachio nuts are given in Table 1. The moisture contents of Uzun and Siirt varieties ranged from 5.0–5.8% to 4.0–4.9%, respectively. The yield of kernel oils varied between 57.1–58.9% and 56.1–62.6%, respectively (Table 1).

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TABLE 1. Moisture Content and Yields of Pistachio Nut Varieties

Locality	Ayvacic	Manisa	Gaziantep	
Varieties	Uzun variety	Siirt variety	Uzun variety	Siirt variety
Moisture (%)	5.0	4.0	5.8	4.9
Yield (%)	57.1	56.1	58.9	62.6

TABLE 2. Fatty Acid Composition of Pistachio Varieties

Fatty acid	Ayvacik Uzun variety	Manisa Siirt variety	Gaziantep	
			Uzun variety	Siirt variety
Myristic (14:0)	Tr.	0.1	0.2	0.1
Pentadecanoic (15:0)	-	Tr.	Tr.	Tr.
Palmitic (16:0)	25.3	13.3	13.0	11.4
(Z)-7-Hexadecenoic (16:1)	-	0.1	0.1	0.1
Palmitoleic (16:1)	0.4	1.1	0.9	0.7
Margaric (17:0)	1.6	Tr.	0.1	0.1
Stearic (18:0)	1.2	2.6	3.1	2.9
Oleic (18:1) (Z-9-octadecenoic)	55.4	60.7	62.6	65.5
Z-7-Octadecenoic acid	1.0	2.0	1.7	1.6
Linoleic (18:2)	14.7	17.8	15.7	16.1
Linolenic (18:3)	0.1	0.3	0.3	0.3
Arachidic (20:0)	Tr.	0.2	0.2	0.3
11-Eicosenoic (20:1)	-	0.5	0.5	0.6
Behenic (22:0)	-	0.1	0.1	0.1
ΣSaturated fatty acid	28.1	16.3	16.7	14.9
ΣUnsaturated fatty acid	71.6	82.5	81.8	84.9
ΣFatty acid	99.7	98.8	98.5	99.8

Tr.: trace < 0.1%.

The kernel oil of Siirt variety from Gaziantep was the highest (62.6%), while Siirt variety from Manisa was the lowest (56.1%). Table 1 indicates that the oil yields in both varieties do not vary significantly.

Fatty acid compositions of oils were analyzed by GC/MS in methyl ester form, and the results are given in Table 2. The major fatty acid components characterized in the oil were as follow: oleic acid (55.4–65.5%), palmitic acid (11.4–25.3%), linoleic acid (14.7–17.8%), stearic acid (1.2–3.1%), and Z-7-octadecenoic acid (1.0–2.0%).

Fatty acid components representing about 98.2–99.8% of total oil were characterized. The amount of saturated and unsaturated fatty acids in kernel oils were found to be 14.9–28.1% and 71.6–84.9%, respectively.

Pentadecanoic acid, (Z)-7-hexadecenoic acid, margaric acid, Z-7-octadecenoic acid, arachidic acid, 11-eicosenoic acid, and behenic acid were determined for the first time in this study.

The main fatty acid component found in pistachio kernels was oleic acid followed by palmitic acid in all studied samples. No significant difference in fatty acid compositions was observed between the two varieties. However, a regional difference was noted. The difference was observed in the Uzun variety grown in the Ayvacik region. While ten fatty acids were characterized in the oil of the Ayvacik sample, fourteen fatty acids each were identified in all the other samples. The oleic acid content ranged between 60.7% and 65.5% in all samples but the Ayvacik sample. The latter contained 55.4% oleic acid and a relatively higher percentage of palmitic acid (25.3%). This may be due to climatic factors [10, 16]. Pistachios grown in hot temperatures (over 25°C) tend to produce low amount of palmitic acid (11.4%–13.3%). Therefore the high temperature in

Gaziantep (25.9°C) and Manisa (26.5°C) results in the production of lower amounts of this saturated acid. The low temperature of the Ayvacik region (22.3°C) may therefore be responsible for the higher content of palmitic acid. The same is also reflected in the content of saturated fatty acids, i.e., 28.1% in the Ayvacik sample; 14.9–16.7% in other samples.

EXPERIMENTAL

Plant Material. Pistachio nuts of two different varieties harvested from 20 year-old trees were obtained from the orchard of the Pistachio Research Institute in Gaziantep in Southeastern Anatolia, and Canakkale (Ayvacik) and Manisa in West Anatolia. Nuts were collected at the date of harvest maturity.

Extraction and Preparation of Fatty Acids. The moisture contents of the kernels were determined using a volumetric water determination apparatus. All the yields were calculated on a dry weight basis. Kernel oils were obtained in petroleum ether for 6 h by Soxhlet extraction. The solvent was evaporated under reduced pressure using a rotary evaporator at 40°C and the residue refluxed with 0.5 N sodium hydroxide solution in methanol (5 ml) for 10 min. After adding 5 ml of 14% BF₃-MeOH solution by a pipette through the condenser, the mixture was boiled for 2 min. Then 5 ml of heptane was added through the condenser and boiled one more minute. After cooling the mixture, 5 mL of saturated NaCl solution was added and the flask was rotated very gently and the required methyl esters were extracted with heptane (2 × 5 ml); then the organic layer was separated using Pasteur pipettes and dried over anhydrous Na₂SO₄. The fatty acid methyl esters were recovered after solvent evaporation [14, 15]. The fatty acid composition of the kernel oils was determined by GC/MS.

Gas Chromatography/Mass spectrometry (GC/MS). A Shimadzu GCMS-QP5050A system with a CPSil 5CB column (25 m × 0.25 µm film thickness) was used with helium as a carrier gas. The GC oven temperature was kept at 60°C and programmed to 260°C at a rate of 5°C/min, then kept constant at 260°C for 40 min. Split flow was adjusted at 50 ml/min. The injector temperature was at 250°C. MS were taken at 70 eV. Mass range was between *m/z* 30 to 425. Identification of individual components was achieved using library search software from The Wiley/NBS Registry Mass Spectral Data and in-house “BASER Library of Fatty Acid Constituents”.

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