

Analysis of Fatty Acid Profiles of Pistachios (*Pistacia vera* L.) and Native Walnuts (*Juglans regia* L.) from Turkey

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This work identifies fatty acid compositions of 7 pistachio varieties (*Pistacia vera* L.) from G. Antep and Siirt (southeastern Turkey) and 9 walnut (*Juglans regia* L.) genotypes from Denizli (western Turkey). Pistachio varieties contained 57.77 % oil, 8.73 % palmitic acid, 0.81 palmitoleic acid, 2.26 % stearic acid, 71.90 % oleic acid, 14.91 % linoleic acid, 0.88 % linolenic acid, 0.08 % myristic acid, 0.11 % arachidic acid and 0.21 % gadoleic acid, respectively. Walnut genotypes contained 65.57 % oil, 5.80 % palmitic acid, 0.16 palmitoleic acid, 2.65 % stearic acid, 59.85 % oleic acid, 14.20 % linoleic acid, 0.88 % linolenic acid, 0.08 % myristic acid, 0.11 % arachidic acid and 0.21 % gadoleic acid, respectively. The mean ratio of unsaturated fatty acids and saturated fatty acids was 8.02 for pistachio varieties and 11.0 for walnut genotypes.

Key Words: Pistachio, Walnut, Oil, Fatty acid composition.

INTRODUCTION

Pistachio and walnut are nut crops, kernels of which contain omega-3 polyunsaturated fatty acids. Today, it is known that omega-3 polyunsaturated fatty acids are used against serious diseases such as heart disease, rheumatoid arthritis, autoimmune disease and cancer¹. In addition, recent studies reveal that they have a major role for human nutrition, diet and health^{2,3}. Therefore, nutritional description of pistachio and walnut genotypes are important not only for nutritional studies both also and nutritional improvement efforts^{4,5}. Although there exist many research findings on fatty acid composition (FAC) of pistachio and walnuts, findings associated with their nutritional identifications based on genotypes and locations are limited. However, related studies indicate that nutritional values of nut crops may vary to genotypes, ecologies, locations and climate conditions. The aim of this work is to identify fatty acid compositions of 7 pistachio varieties (*Pistacia vera* L.) from G. Antep (southeastern Turkey) and 9 walnut (*Juglans regia* L.) genotypes from Denizli (western Turkey).

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EXPERIMENTAL

The material of this research was kernels of 7 pistachio varieties (*Pistacia vera* L.) from G. Antep (southeastern Turkey) and 9 walnut (*Juglans regia* L.) genotypes from Denizli (western Turkey). Walnut genotypes were collected from Serinhisar and Kocapinar districts in Denizli city. Fruits of pistachio and walnut were harvested, their shells were removed and then kernels were dried in a vacuum oven at 60 °C for three days. The values of kernel weight and shell thickness were recorded for each genotype using three replications. The mean values were found using 20 fruit samples for each replicate.

Oil contents (ether-extractable) of pistachio and walnut kernels were determined according to standard AOAC⁶ procedure. To prepare the fatty acid methyl esters (FAME), 0.4 g oil were dissolved in 4 mL of isooctane and methylated in 0.2 mL of 2 M methanolic KOH. Fatty acid methyl ester analysis was performed on an Agilent 6890 series gas-chromatography equipped with flame-ionization detector and a 60 m capillary column (ID = 0.25 mm) coated with 0.25 µm of 50 %-cyanopropyl-methylpolysiloxane (J & W Scientific, Folsom, CA, USA). Helium was used as a carrier gas at a flow rate of 1.5 mL/min and a split ratio of 1:10. Injector temperature was 250 °C, detector temperature was 260 °C and the oven temperature was programmed at 120 °C for a hold of 5 min and increased to 240 °C at a rate of 15 °C/min and hold at the final temperature for 20 min⁷. Fatty acid methyl esters were identified by comparison of their retention time and equivalent chain length with respect to standard FAMEs (Supelco. 47885-U). Fatty acid methyl esters in kernels were quantified according to their percentage area⁶. All the samples were analyzed in triplicate.

RESULTS AND DISCUSSION

The kernel dry matter contents of varieties and genotypes of pistachio were from 93.7 to 97.7 %. Their kernel fat contents were between 52.15 and 59.26 %. As percentage of fat, their kernels had 70.24-74.76 % oleic acid, 11.56-16.54 % linoleic acid, 0.77-0.97 % linolenic acid, 0.62-1.04 % palmitoleic acid, 0.07-0.23 % arachidic acid and 0.15-0.27 % gadoleic acid. The mean values of fat, oleic acid, linoleic acid, linolenic acid, palmitoleic, arachidic acid and gadoleic acid were 57.77, 71.90, 14.91, 0.88, 0.81, 0.11 and 0.21 %, respectively (Table-1).

The kernels of varieties and genotypes of pistachio had 7.98-9.58 % palmitic acid, 1.25-3.32 % stearic acid, 0.07-0.11 % myristic acid, 87.78-90.31 % UFA (unsaturated fatty acids), 9.67-12.21 % SFA (saturated fatty acids) and 7.19-9.34 UFA/SFA ratio. The mean values of palmitic acid, stearic acid, myristic acid, UFA, SFA and UFA/SFA were 8.73, 2.26, 0.08, 88.02, 11.90 and 7.40 %, respectively (Table-2). The mean values of fat content, unsaturated and saturated fatty acids of pistachio varieties and genotypes were shown in Fig. 1.

The kernel dry matter contents of walnut genotypes were from 97.0 to 97.6 %. Their kernel fat contents were between 62.2 and 70.2 %. The kernels of walnut had 15.68-23.57 % oleic acid, 53.49-63.06 % linoleic acid, 12.74-15.85 % linolenic

TABLE-1
DRY MATTER, FAT AND UNSATURATED FATTY
ACIDS OF PISTACHIO VARIETIES

Variety/ Genotype	Dry matter (%)	Fat content (%)	Oleic acid C18:1	Linoleic acid C18:2	Linolenic acid C18:3	Palmitoleic acid C16:1	Arachidic acid C20:0	Gadoleic acid C20:1
Uzun	97.70	58.92	70.24	16.54	0.91	0.77	0.09	0.23
Halebi	96.50	55.52	70.62	15.31	0.85	0.75	0.09	0.27
Siirt	97.40	63.21	72.55	15.40	0.97	0.62	0.10	0.20
Ohadi	97.00	57.56	71.80	16.39	0.97	0.77	0.23	0.15
Pervari-71	93.70	59.26	71.44	14.28	0.77	0.93	0.11	0.25
Pervari-72	94.70	52.15	74.76	11.56	0.84	1.04	0.07	0.17
Mean	96.16	57.77	71.90	14.91	0.88	0.81	0.11	0.21

TABLE-2
SATURATED FATTY ACIDS OF PISTACHIO VARIETIES

Variety/ Genotype	Palmitic acid C16:0	Stearic acid C18:0	Myristic acid C14:0	UFA (%)	SFA (%)	UFA/ SFA
Uzun	8.52	2.60	0.10	88.78	11.22	7.91
Halebi	8.68	3.32	0.11	87.89	12.11	7.25
Siirt	7.98	2.05	0.08	89.84	10.11	8.87
Ohadi	8.34	1.25	0.08	90.31	9.67	9.34
Pervari-71	9.31	2.81	0.09	87.78	12.21	7.19
Pervari-72	9.58	1.56	0.07	88.44	11.21	7.89
Mean	8.73	2.26	0.08	88.82	11.07	8.02

UFA = Unsaturated fatty acids, SFA = Saturated fatty acids.

acid, 0.11-0.21 % palmitoleic acid, 0.24-0.35 % arachidic acid and 0.19-0.26 % gadoleic acid. The mean values of fat, oleic acid, linoleic acid, linolenic acid, palmitoleic acid, arachidic acid and gadoleic acid were 65.57, 18.65, 59.85, 14.20, 0.16, 0.30 and 0.22 %, respectively (Table-3).

TABLE-3
DRY MATTER, FAT AND UNSATURATED FATTY ACIDS OF
WALNUT GENOTYPES FROM DENIZLI, TURKEY

Walnut genotypes	Dry matter (%)	Fat content (%)	Oleic acid C18:1	Linoleic acid C18:2	Linolenic acid C18:3	Palmitoleic acid C16:1	Arachidic acid C20:0	Gadoleic acid C20:1
DW1	97.50	63.60	20.43	57.78	14.69	0.15	0.31	0.24
DW2	97.30	62.20	21.76	56.24	14.24	0.17	0.30	0.20
DW3	97.20	63.90	15.68	62.88	14.56	0.16	0.27	0.21
DW4	97.00	66.80	17.72	62.79	12.74	0.15	0.33	0.23
DW5	97.30	66.10	16.75	61.99	13.32	0.11	0.33	0.26
DW6	97.50	65.30	15.75	63.06	14.83	0.16	0.35	0.21
DW7	97.60	70.20	16.81	62.22	13.67	0.16	0.24	0.19
DW8	97.40	68.70	23.57	53.49	15.85	0.18	0.30	0.24
DW9	97.10	63.40	19.40	58.24	13.97	0.21	0.28	0.22
Mean	97.32	65.57	18.65	59.85	14.20	0.16	0.30	0.22

The kernels of walnut genotypes had 5.12-6.69 % palmitic acid, 1.91-3.02 % stearic acid, 0.01-0.03 % myristic acid, 92.32-94.36 % unsaturated fatty acids (UFA), 7.85-9.70 % saturated fatty acids (SFA) and 9.5-12.0 UFA/SFA ratio. The mean values of palmitic acid, stearic acid, myristic acid, UFA, SFA and UFA/SFA were 5.80 %, 2.65 %, 0.02 %, 93.38 %, 8.47 % and 11.0, respectively. In addition, their nut size, kernel size and shell thickness values were recorded as 10.5 g, 5.4 g and 1.52 mm, respectively. Kernel colours were light in 5 genotypes and dark in 4 genotypes (Table-4). The mean values of fat content, unsaturated and saturated fatty acids of walnut genotypes were shown in Fig. 2.

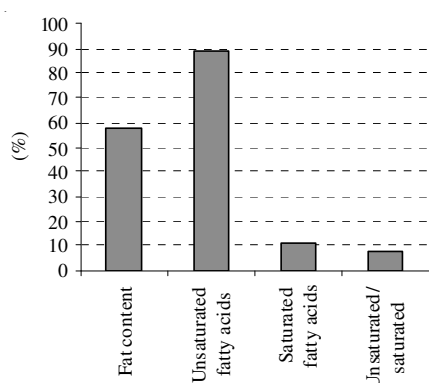


Fig. 1. Mean fat content, unsaturated and saturated fatty acids of pistachios

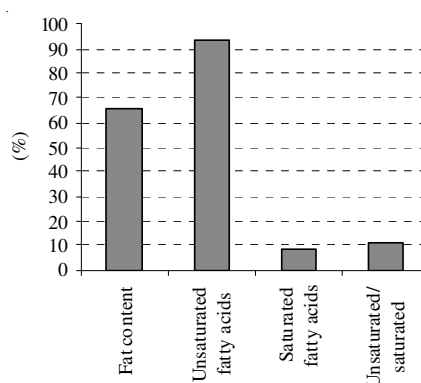


Fig. 2. Mean fat content, unsaturated and saturated fatty acids of walnut genotypes

TABLE-4
SATURATED FATTY ACID CONTENTS, KERNEL SIZE AND SHELL THICKNESS OF WALNUT GENOTYPES FROM DENIZLI, TURKEY

Walnut genotypes	Palmitic acid C16:0	Stearic acid C18:0	Myristic acid C14:0	UFA (%)	SFA (%)	UFA /SFA	NS (g)	KS (g)	ST (mm)	Kernel colour
DW1	5.65	2.73	0.02	93.60	8.40	11.1	11.8	5.8	2.06	Light
DW2	6.16	1.91	0.01	92.91	8.08	11.5	11.7	5.6	1.82	Light
DW3	5.60	2.62	0.02	93.76	8.24	11.3	9.4	5.1	1.36	Light
DW4	5.12	2.88	0.02	93.96	8.02	11.7	10.6	6.0	1.39	Light
DW5	6.18	3.02	0.03	92.76	9.23	10.0	9.9	5.2	1.37	Dark
DW6	5.44	2.39	0.02	94.36	7.85	12.0	7.3	3.4	1.34	Dark
DW7	5.82	2.56	0.02	93.29	8.40	11.1	12.7	6.3	1.42	Dark
DW8	5.57	2.78	0.03	93.63	8.38	11.1	10.9	5.4	1.26	Light
DW9	6.69	2.98	0.03	92.32	9.70	9.5	10.8	5.7	1.69	Dark
Mean	5.80	2.65	0.02	93.38	8.47	11.0	10.5	5.4	1.52	

UFA = Unsaturated fatty acids, SFA = Saturated fatty acids, U/S = Unsaturated/saturated, NS = Nut size, KS = Kernel size, ST = Shell thickness.

Pistachio nuts usually contain the fat over 55 %⁸⁻¹¹. Fatty acid compositions of nuts are affected by ecologies and varieties^{8,12}. Findings regarding fat contents and fatty acid composition of pistachio varieties and genotypes are generally in harmony

with those of related references^{8-11,13}. In walnuts, fat contents have been reported from 57 to 69 %¹⁴⁻¹⁶. In addition, walnut genotypes had lower linoleic acid contents but higher oleic acid contents than those from Li *et al.*¹⁷ and Amaral *et al.*¹⁸. Walnut genotypes with higher unsaturated fatty acid contents may be valuable for nutritional breeding efforts.

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