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Fatty Acid Composition in Some Species of Walnuts Grown in Turkey

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ABSRACT

Walnut samples obtained from nineteen different 1:Hartley, 2:206, 3:Serr, 4:Mitlant, 5:Fernor, 6:Pedro, 7:Payne, 8:Oguzlar, 9:Fernette, 10:46, 11:Howard, 12:Akca 2, 13:39, 14:Sen 1, 15:Maras 18, 6: 91, 17:Sili yerel, 18:58, 19:46, in Anatolia. The present study describes the determination of fatty acid composition of the oil samples obtained from some walnut and the comparison of variations species. The fatty acid compositions of walnut samples were determined by Shimadzu 15-A Gas Chromatography. According to the results, fatty acid composition of the walnut samples is significantly varied depending on each species.

1. Introduction

Many scientific publications, for at least 3000 years, people living in Anatolia, known acquaintances walnut (Ferhatoglu, 2001). Walnut, high nutritional value is a fruit. Walnut fruit is very rich in essential fatty acids and tocopherols. Linoleic acid, oleic, linoleic, palmitic and stearic acids decrease LDL cholesterol and raises HDL cholesterol. Cardiovascular diseases are important protective (Pereira et al. 2007). Several studies, especially walnut tree bark, leaves, green fruit peel and antimicrobial activity of juglon matter were also determined (Clark et al., 1990; Oliveira et al. 2008).

Walnut which carbohydrates, vitamins and all amino acids is supply; oil (50-80%), protein (12-15), mineral compound (3%) for the feeder is a feature. Due to their low sugar (2.5-4%) diet the amount of good fruit (Mitrovic et al. 1997). Many researchers' minerals such as potassium and magnesium in walnut stated that regulates blood pressure (Prineas et al, 1993). As well as the consumption of fruits, cakes and pastries is used as a flavor enhancer (Olez et al. 1974).

According to literature information, fatty acid composition of walnut has not been investigated. The aim of this study is to determine the fatty acid compositions and ω6/ω3 ratios of the oil samples obtained from some *walnut* grown in Anatolia, and to compare species.

2. Materials and Methods

Collection of samples

Nineteen walnut samples were collected from the different regions of Anatolia in order to determine the fatty acid compositions for 1: Hartley, 2: 206, 3: Serr, 4: Mitlant, 5: Fernor, 6: Pedro, 7: Payne, 8: Oguzlar, 9: Fernette, 10: 46, 11: Howard, 12: Akca 2, 13: 39, 14: Sen 1, 15: Maras 18, 16: 91, 17: Sili yerel, 18: 58, 19: 46.

Preparation of the samples

The walnuts were collected from the ground and were then washed and dried in a forced-air drier at 30°C to a moisture content of ca. 9%. The nuts were then opened using a standard method, and the kernels were vacuum-packed in plastic bags and stored at −70°C until they could be extracted. Identification of the species of walnut collected was carried out according to the usual procedures, based on methods suggested by (Baron et al. 1985; McNeil et al. 1994), at the deep-freeze of the Department of Animal Nutrition at Selcuk University.

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Fatty acid analysis

Fat extraction was carried out according to the AOAC. The each part of about 5 g was extracted with chloroform/methanol mixture (2/1, v/v) (Folch et al., 1957). The fatty acids were converted to their methyl esters using standard Boron trifluoride-methanol method (Moss et al. 1974). The resultant fatty acid methyl esters were separated and stored at -20 ºC. At the beginning of each analysis, the samples were allowed to equilibrate to room temperature and analysed by gas chromatography (Shimadzu 15-A), equipped with dual flame ionisation detector and a 1.8 m × 3 mm internal diameter packed glass column containing GP 10 % SP–2330 on 100/120 Chromosorb WAW, cat no: 11851. Column temperature was 195 °C for 32 min., and then rose progressively at 30 ºC/min up to 225 °C where it was maintained for 11 min at 220 °C. Carrier gas was nitrogen (2 ml/min). The injector and detector temperatures were 230 and 240 °C respectively. Conditions were chosen to separate fatty acids of carbon chain length from 8 to 24. The fatty acids were identified by comparison of retention times with known external standard mixtures (Alltech), quantified by a Shimadzu Class-VP software and the results were expressed as percentage distribution of fatty acid methyl esters. Each of the experiments was repeated three times.

Statistical analysis

Nineteen walnut samples were analyzed for each parts of species were analyzed in triplicate. The average results of peak area are offered as means ± SD. The statistical analysis of the percentages of fatty acid was tested by analysis of variance (ANOVA) and comparisons between mean values were performed Duncan's test. Differences between means were reported as significant if $P < 0.05$.

3. Results and Discussion

Lipid content is around 70% in oil samples obtained from walnut species. The fatty acid compositions of parts of the walnut samples and retention times are presented in Table 1. It was identified 24 fatty acids for the walnut samples and evaluated their compositions for species. The highest fatty acid ratios are as follows; linoleic acid 18:2ω6 (64.42%) in Sili yerel, palmitic acid 16:0 (6.52%) in 206 species, oleic acid 18:1 (19.23%) in Oguzlar, stearic acid 18:0 (3.59%) in Oğuzlar, myristic acid 14:0 (0.07%) in Hartley. Linoleic acid is the most abundant polyunsaturated fatty acid in all parts. Palmitic acid is the most abundant saturated fatty acid in all parts. The total SFA (saturated fatty acid) composition of the studied species is assigned between 6.93-9.68% while PUFA (poly unsaturated fatty acid) composition is 71.02-77.04%.

Table 1
Fatty Acid Composition of Oil Samples Obtained from *Walnut* Species

Fatty Acids	1	2	3	4	5	6	7
C 8:0	0.07±0.05a	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.01±0.01b
C 10:0	0.00±0.01a	0.01±0.01a	0.01±0.00a	0.01±0.00a	0.02±0.01a	0.01±0.01a	0.01±0.01a
C 12:0	0.00±0.00a	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab
C 14:0	0.07±0.05a	0.02±0.01c	0.04±0.01abc	0.04±0.01abc	0.01±0.01c	0.01±0.00c	0.02±0.00c
C 16:0	6.28±0.30a	6.52±0.43a	5.45±1.06abc	6.00±0.03abc	6.26±0.99a	6.18±0.20ab	4.26±0.30c
C 17:0	0.19±0.15bc	0.11±0.02c	0.17±0.04bc	0.14±0.01bc	0.83±0.64a	0.56±0.39ab	0.16±0.06bc
C 18:0	1.55±0.44cd	1.68±0.37cd	2.04±0.43bcd	1.85±0.03cd	1.37±0.09d	1.65±0.33cd	2.53±0.51abc
C 20:0	0.03±0.01ab	0.02±0.01ab	0.03±0.00ab	0.02±0.00ab	0.02±0.01ab	0.02±0.01ab	0.02±0.00ab
C 21:0	0.02±0.01abc	0.01±0.00c	0.01±0.00bc	0.01±0.00bc	0.01±0.00bc	0.01±0.00c	0.02±0.00bc
C 24:0	0.01±0.01ab	0.01±0.01ab	0.01±0.01ab	0.00±0.00b	0.01±0.00a	0.01±0.01ab	0.01±0.01ab
∑ SFA	8.14±0.06ab	8.39±0.64ab	7.75±0.60ab	8.08±0.01ab	8.54±1.26ab	8.46±0.12ab	7.02±0.24b
C 14:1	0.00±0.00a	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab
C 16:1	0.05±0.01a	0.02±0.01bc	0.03±0.01bc	0.03±0.00bc	0.02±0.01bc	0.02±0.00bcd	0.01±0.01cd
C 17:1	0.01±0.01ab	0.01±0.01ab	0.02±0.01ab	0.01±0.00ab	0.00±0.00b	0.01±0.01ab	0.02±0.02ab
C 18:1	17.56±0.58a	17.49±1.25a	17.70±0.15a	17.62±0.04a	17.08±1.74a	15.70±1.40a	15.90±2.98a
C 20:1	0.03±0.01ab	0.01±0.00abcd	0.01±0.01abcd	0.02±0.00abcd	0.02±0.00abcd	0.01±0.00abcd	0.01±0.00cd
C 22:1	0.01±0.00a	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b
C 24:1	0.00±0.00bc	0.00±0.00abc	0.00±0.00bc	0.00±0.00abc	0.00±0.00ab	0.00±0.00abc	0.00±0.00bc
∑ MUFA	17.65±0.58a	17.54±1.26a	17.77±0.15a	17.69±0.04a	17.13±1.75a	15.74±1.40a	15.94±2.99a
C 18:2	60.35±1.07ab	60.17±2.67ab	60.71±0.40ab	60.53±0.06ab	63.46±0.66ab	61.07±3.58ab	64.40±3.40a
C 18:3	13.85±1.62a	13.87±3.39a	13.74±0.12a	13.67±0.10a	10.86±1.35a	14.70±2.34a	12.60±1.26a
C 20:2	0.00±0.01bc	0.01±0.01abc	0.01±0.00abc	0.01±0.00abc	0.00±0.00c	0.01±0.01abc	0.01±0.01abc
C 20:4	0.00±0.01b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b
C 20:5	0.00±0.00b	0.01±0.01b	0.01±0.00b	0.01±0.00b	0.00±0.00b	0.01±0.01b	0.01±0.00b
C 22:4	0.00±0.00b	0.01±0.01ab	0.01±0.01ab	0.01±0.00ab	0.00±0.00b	0.01±0.01ab	0.02±0.01ab
C 22:5	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a
∑ PUFA	74.20±0.64ab	74.07±0.76ab	74.49±0.46ab	74.23±0.04ab	74.33±1.93ab	75.80±1.34ab	77.04±3.20a
∑ ω3	13.85±1.62a	13.88±3.40a	13.75±0.12a	13.69±0.10a	10.87±1.35a	14.71±2.35a	12.61±1.26a
∑ ω6	60.35±1.07ab	60.19±2.65ab	60.74±0.41ab	60.55±0.06ab	63.47±0.66ab	61.09±3.56ab	64.43±3.38a
∑ SFA/PUFA	0.01±0.00ab	0.11±0.01ab	0.10±0.01b	0.11±0.00ab	0.12±0.02ab	0.11±0.01ab	0.09±0.01b

Table 1 Continued

Fatty Acids	8	9	10	11	12	13
C 8:0	0.01±0.01b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b
C 10:0	0.00±0.00a	0.01±0.01a	0.01±0.01a	0.01±0.01a	0.01±0.01a	0.00±0.00a
C 12:0	0.00±0.00b	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00a
C 14:0	0.04±0.02abc	0.04±0.02abc	0.02±0.00c	0.02±0.00c	0.02±0.01c	0.03±0.02bc
C 16:0	5.72±1.56abc	5.05±0.85abc	4.21±0.31c	4.26±0.30c	4.99±1.17abc	5.80±0.78abc
C 17:0	0.29±0.10bc	0.09±0.06c	0.16±0.05bc	0.16±0.06bc	0.13±0.05bc	0.19±0.15bc
C 18:0	3.59±0.71a	2.35±0.76bcd	2.61±0.53abc	2.53±0.51abc	2.27±0.44bcd	1.53±0.27cd
C 20:0	0.01±0.01c	0.03±0.01ab	0.02±0.00ab	0.02±0.00ab	0.02±0.00ab	0.03±0.01a
C 21:0	0.03±0.01a	0.02±0.00bc	0.02±0.00bc	0.02±0.00bc	0.01±0.01bc	0.02±0.01bc
C 24:0	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b
∑ SFA	9.68±2.37a	7.60±0.72ab	7.05±0.25b	7.02±0.24b	7.47±0.91b	7.59±0.87ab
C 14:1	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00b	0.00±0.00ab
C 16:1	0.02±0.01bcd	0.02±0.01bc	0.00±0.00d	0.02±0.01bcd	0.01±0.00cd	0.04±0.01ab
C 17:1	0.03±0.01a	0.01±0.00ab	0.01±0.00ab	0.03±0.02a	0.02±0.01ab	0.02±0.01ab
C 18:1	19.23±1.81a	16.45±3.53a	17.35±0.00a	18.80±2.08a	15.57±2.72a	16.65±1.23a
C 20:1	0.02±0.01abcd	0.02±0.01abcd	0.01±0.00abcd	0.02±0.01abcd	0.01±0.00d	0.03±0.01abc
C 22:1	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b
C 24:1	0.00±0.00bc	0.00±0.00bc	0.00±0.00a	0.00±0.00bc	0.00±0.00bc	0.00±0.00bc
∑ MUFA	19.31±1.84a	16.50±3.55a	17.38±0.00a	18.87±2.12a	15.61±2.73a	16.74±1.22a
C 18:2	61.45±1.70ab	61.18±6.49ab	60.50±3.49ab	64.28±2.81a	62.59±5.22ab	59.87±0.80ab
C 18:3	9.49±3.72a	14.69±2.66a	15.03±3.73a	9.79±4.28a	14.28±2.56a	15.78±2.84a
C 20:2	0.02±0.01ab	0.01±0.01abc	0.01±0.01abc	0.01±0.01abc	0.01±0.01abc	0.01±0.01abc
C 20:4	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b
C 20:5	0.03±0.03a	0.01±0.00b	0.01±0.00b	0.01±0.00b	0.02±0.01b	0.01±0.01b
C 22:4	0.02±0.02a	0.01±0.00ab	0.01±0.01ab	0.02±0.01ab	0.02±0.01ab	0.01±0.00ab
C 22:5	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a	0.00±0.00a
∑ PUFA	71.02±4.16b	75.90±4.24ab	75.57±0.25ab	74.11±1.89ab	76.92±3.30a	75.68±2.07ab
∑ ω3	9.52±3.74a	14.70±2.66a	15.04±3.73a	9.80±4.28a	14.30±2.57a	15.78±2.84a
∑ ω6	61.50±1.68ab	61.20±6.48ab	60.53±3.49ab	64.31±2.80a	62.62±5.20ab	59.89±0.79ab
∑ SFA/PUFA	0.14±0.04a	0.10±0.02b	0.09±0.00b	0.10±0.00b	0.10±0.02b	0.10±0.01b
Fatty Acids	14	15	16	17	18	19
C 8:0	0.00±0.00b	0.00±0.00b	0.01±0.01b	0.00±0.00b	0.00±0.00b	0.06±0.07a
C 10:0	0.00±0.00a	0.01±0.01a	0.01±0.01a	0.01±0.01a	0.01±0.01a	0.00±0.00a
C 12:0	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00a	0.00±0.00ab	0.00±0.00ab
C 14:0	0.03±0.01bc	0.02±0.01c	0.03±0.02abc	0.02±0.00c	0.02±0.01c	0.06±0.06ab
C 16:0	5.55±1.14abc	4.82±1.25abc	5.25±1.73abc	4.37±1.21bc	4.87±1.21abc	5.29±1.06abc
C 17:0	0.16±0.05bc	0.41±0.37bc	0.22±0.15bc	0.12±0.05bc	0.42±0.36bc	0.17±0.14bc
C 18:0	2.10±0.40bcd	2.31±0.85bcd	3.06±1.06ab	2.35±0.59bcd	2.23±0.75bcd	2.24±0.74ab
C 20:0	0.02±0.00ab	0.02±0.00ab	0.02±0.01bc	0.02±0.00ab	0.03±0.00ab	0.02±0.01bc
C 21:0	0.01±0.00bc	0.02±0.00bc	0.02±0.01abc	0.02±0.00bc	0.02±0.00bc	0.03±0.02ab
C 24:0	0.01±0.01ab	0.01±0.01ab	0.00±0.00b	0.00±0.00b	0.01±0.01ab	0.01±0.01ab
∑ SFA	7.88±0.75ab	7.61±0.81ab	8.62±2.80ab	6.93±0.28b	7.58±0.83ab	8.63±1.45ab
C 14:1	0.00±0.00ab	0.00±0.00b	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab	0.00±0.00ab
C 16:1	0.02±0.00bc	0.03±0.01bc	0.02±0.02bc	0.03±0.01ab	0.02±0.01bcd	0.02±0.01bc
C 17:1	0.02±0.02ab	0.02±0.01ab	0.02±0.02ab	0.01±0.01ab	0.02±0.02ab	0.02±0.02ab
C 18:1	17.06±2.66a	15.32±1.27a	17.54±3.55a	15.85±2.11a	16.52±2.11a	18.32±0.53a
C 20:1	0.02±0.01abcd	0.02±0.01abcd	0.02±0.01abcd	0.03±0.01a	0.01±0.00bcd	0.02±0.01abcd
C 22:1	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b	0.00±0.00b
C 24:1	0.00±0.00abc	0.00±0.00abc	0.00±0.00abc	0.00±0.00bc	0.00±0.00bc	0.00±0.00bc
∑ MUFA	17.12±2.67a	15.39±1.27a	17.60±3.59a	15.93±2.13a	16.57±2.12a	18.39±0.53a
C 18:2	61.35±1.44ab	61.51±3.91ab	57.56±4.00b	64.42±4.65a	62.70±1.80ab	60.44±0.97ab
C 18:3	13.63±0.99a	15.44±2.29a	16.17±9.48a	12.71±5.61a	13.11±0.59a	12.49±1.26a
C 20:2	0.01±0.00abc	0.01±0.01abc	0.02±0.00a	0.01±0.01abc	0.01±0.01abc	0.01±0.01abc
C 20:4	0.00±0.00b	0.00±0.00b	0.01±0.00b	0.00±0.00b	0.00±0.00b	0.01±0.01a
C 20:5	0.01±0.00b	0.01±0.00b	0.02±0.01b	0.01±0.01b	0.01±0.01b	0.01±0.01b
C 22:4	0.01±0.00ab	0.02±0.01ab	0.02±0.02ab	0.00±0.00ab	0.02±0.01ab	0.02±0.02ab
C 22:5	0.00±0.00a	0.00±0.00a	0.00±0.01a	0.00±0.00a	0.00±0.00a	0.00±0.01a
∑ PUFA	75.01±2.40ab	77.00±2.04a	73.79±6.27ab	77.15±1.94a	75.85±1.29ab	72.98±1.97ab
∑ ω3	13.64±0.99a	15.45±2.29a	16.19±9.49a	12.72±5.60a	13.13±0.60a	12.51±1.25a
∑ ω6	61.37±1.43ab	61.54±3.92ab	57.60±4.00b	64.43±4.65a	62.72±1.78ab	60.47±0.94ab
∑ SFA/PUFA	0.11±0.01ab	0.10±0.01b	0.12±0.05	0.09±0.00b	0.10±0.0b	0.12±0.02ab

The countries - 1: Hartley, 2: 206, 3: Serr, 4: Mitlant, 5: Fernor, 6: Pedro, 7: Payne, 8: Oguzlar, 9: Fernette, 10: 46, 11: Howard, 12: Akca 2, 13: 39, 14: Sen 1, 15: Maras 18, 16: 91, 17: Sili yerel, 18: 58, 19: 46.

The highest value in the same line is denoted with a, the lowest value is denoted with h, and the value between a and h is denoted with other.

If the value has denotation of ab, bc (or cd) it is found in the range of a and b, b and c, c and d.

a, b, c, d values for each sample with different letters in the same fraction are significantly different at P <0. 05.

Oleic acid is mostly found in Oguzlar and the major MUFA, contributing approximately 15.32-19.23% to the total SFA content. The level of MUFA (mono unsaturated fatty acid) depends on level of oleic acid. The greatest proportion of oleic acid is found in Oguzlar. EC (1980) reported that erucic acid 22:1ω9 in vegetable oils had to be found at a maximum value of 5.0% for the human health. In this study, erucic acid was found to be between 0 and 0.01% in all species.

Dyerberg (1986) noted that an increase in the ratio of ω3/ω6 PUFA increased the availability of ω3 PUFAs, which are beneficial for human health. The long chain ω3 and ω6 fatty acids commonly are called PUFAs. Long-chain ω3 PUFAs cannot be readily synthesised by human bodies and mostly are obtained through the diet, and ratios of ω3/ω6 are considered to be important (Alasalvar et al. 2002). The lowest linoleic acid content (57.56%) is found to be in 96 species. Nutritionists suggested that ω3 fatty acids had to be found more in human diet. Therefore, they reported that ω6/ω3 ratio had to be values below 4.0 for the human health (HMSO 1994). In the present study, ω6/ω3 ratio is found 3.56% in 91 species and 6.56% in Howard.

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