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Fatty Acid and Dietary Fibre Content of Walnut (*Juglans regia* L.) Varieties Grown in Turkey

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Walnuts (*Juglans regia* L.), as part of healthy diet, contain multiple beneficial components such as unique fatty acid profile and high levels of Vitamin E, fibre and polyphenols. In this work, fatty acid profile and dietary fibre content of new walnut varieties grown in Turkey have been reported. For this purpose walnut samples were collected from 18 different varieties and genotypes grown in Turkey. Four international commercial varieties ('Heartley', 'Pedro', 'Chandler' and 'Serr'), three Turkish commercial varieties ('Kaman', 'Sebin', 'Bilecik') and 11 new promising new genotypes were evaluated in terms of their fatty acid profile and total dietary fibre contents. Fatty acid composition was determined by gas chromatography and total dietary fibre determination was done by enzymatic-gravimetric procedure. Potential health benefits of newly selected Turkish walnut varieties showed promising results since 6 out of 14 newly selected varieties had more than 70% PUFA and all the new selections except one had more than 10% dietary fibre content.

Key Words: Healthy diet, PUFA, Turkish walnut cultivars.

INTRODUCTION

Walnuts, as part of healthy diet, contain multiple beneficial components such as unique fatty acid profile and high levels of Vitamin E, fibre and polyphenols[1]. Walnuts, as do other nuts, have a high fat content but are low in saturated fatty acids. Among the nuts, they contain higher linoleic and linolenic polyunsaturated fatty acids rather than the monounsaturated acids[2,3]. Due to these unique characteristics walnuts have generated considerable interest on healthy diet research. Recent epidemiological studies suggest that enriching the diet with walnut lowers plasma total cholesterol and LDL cholesterol reduces risk of coronary heart disease and does not cause gain in body weight when eaten as a replacement food[1,4,5–11]. Some research data also indicate that increasing the

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amount of fibre in the diet may decrease the incidence of colon cancer; such a diet may also improve your cholesterol and help prevent heart disease[1, 4, 7].

Depending on the cultivar, irrigation rate and location, walnut kernels (*Juglans regia* L.) generally contain about 60% oil[2, 3, 12]. The major fatty acids found in walnut are oleic (18 : 1 n-9), linoleic (18 : 2 n-6) and linolenic (18 : 3 n-3) acids. Total fatty acid profile is composed of about 50–60% linoleic acid and about 10% linolenic acid. Apart from high polyunsaturated fatty acids content, walnut has also has high levels of dietary fibre[6, 13].

The fatty acid profile of commonly grown walnuts is known[2, 3, 14]. However, newly bred or selected new cultivars may promise superior characteristics particularly on their fatty acid composition and dietary fibre content. There is no significant study on this area to explore this opportunity. As clinical and epidemiological research continues to document the positive health effects of foods high in dietary fibre and polyunsaturated fatty acids, the present study aims to gain more in-depth knowledge on fatty acid profile and fibre content of new walnut varieties and genotypes grown in Turkey. Also, these findings may help to provide the importance of walnut consumption and higher economic value for walnut growers.

EXPERIMENTAL

Walnut kernel samples were collected from the province of Maras in Turkey in 2003. Trees were grafted from clonal material on seedling rootstock of *Juglans regia*. Total of 18 varieties and genotypes were investigated in this study. Three Turkish commercial varieties ('Kaman', 'Sebin' and 'Bilecik') and 11 promising new genotypes from local selections were evaluated. Four popular commercial cultivars ('Heartley', 'Pedro', 'Chandler' and 'Serr') were also included in the experiment to compare and contrast with all new varieties and genotypes grown in Turkey.

The harvesting and drying conditions followed the standard methods. Analysis was carried out on bulk harvest samples. The oil was extracted from the kernels using a small hand-held cold press. The oil was placed in screw-capped test tubes and flushed with N_2 gas and stored at 4°C until analysis commenced the following day.

Fatty acid analysis

Walnut sample fat components were extracted by diethyl ether at low temperature. They were converted to methyl esters in the mixture of petroleum ether/sulfuric acid/methanol by boiling under back boiling which was carried out by taking the organic phase according to the IUPAC method[15]. After filtration (0.45% μm pore size), the samples were subjected to gas chromatography (HP 5890) equipped with FID detector, fitted with fused-silica column. Hydrogen gas was used as the carrier and detection was made by a flame ionization detector. Oven temperature was maintained isothermally at 200°C and the flow rate of nitrogen was 30 mL/min.

Total dietary fibre determination

Samples were analyzed for soluble and insoluble dietary fibre fractions according to AOAC method[16], an enzymatic-gravimetric procedure using MES-TRIS buffer and digestion with heat-stable α-amylase at 95–100°C, protease at 60°C and amyloglucosidase at 60°C[17]. Total dietary fibre was calculated as the sum of soluble and insoluble dietary fibre.

RESULTS AND DISCUSSION

Palmitic acid, palmitoleic acid, stearic acid, oleic acid, linoleic acid and linolenic acid were the main fatty acids found in walnut kernels (Table-1). Other fatty acids were found only in trace amounts (data was not included).

TABLE-1
DISTRIBUTION OF FATTY ACIDS AND DIETARY FIBRE CONTENT OF WALNUTS GROWN IN TURKEY

(Fatty acids were presented as per cent of total fat. Total dietary fibre was calculated as the sum of soluble and insoluble dietary fibre and expressed as g/100 g fresh weight.)

Varieties	Fatty acids						Dietary fiber (g/100 g FW)
	C 16 : 0	C 18 : 0	C 18 : 1	C 18 : 2	C 18 : 3	PUFA	
Hartley	5.69±0.33	3.27±0.31	15.82±0.53	63.54±0.98	11.25±0.48	74.79	11.01
Pedro	6.65±0.27	2.73±0.28	14.14±0.42	60.22±1.03	15.90±0.18	76.12	11.30
Chandler	6.18±0.37	3.02±0.21	16.04±0.32	56.68±0.83	15.80±0.12	72.48	9.83
Serr	6.61±0.03	3.12±0.28	20.23±0.43	54.97±1.03	14.68±0.32	69.65	10.11
Akca 1	7.08±0.25	2.36±0.21	18.40±0.48	56.94±0.95	14.84±0.43	71.78	10.10
Hidayet	5.50±0.32	3.03±0.32	16.53±0.42	62.71±0.85	11.86±0.15	74.57	nd
Kaman	6.78±0.25	2.80±0.25	17.44±0.58	60.82±0.93	11.71±0.09	72.53	nd
Sebin	**5.58±0.32**	**2.75±0.35**	**22.55±0.48**	**55.81±1.05**	**12.93±0.20**	**68.74**	**12.26**
Bilecik	5.76±0.30	2.83±0.28	20.99±0.43	56.85±1.03	13.14±0.03	69.99	10.73
Mert	6.50±0.25	3.44±0.31	21.94±0.53	58.26±0.93	9.40±0.51	67.66	11.73
Seker-2	6.32±0.40	3.15±0.35	14.67±0.52	64.42±1.01	11.10±0.21	75.52	10.59
Seker-3	6.69±0.40	3.28±0.32	16.10±0.44	62.98±1.03	10.71±0.25	73.69	12.59
Sutyemez-1	8.11±0.32	3.22±0.35	21.30±0.48	58.07±1.05	8.99±0.20	67.06	12.40
Sutyemez-2	6.81±0.41	2.87±0.32	18.78±0.44	57.69±1.01	13.43±0.25	71.12	11.12
Bursa-95	7.61±0.32	3.28±0.32	21.49±0.42	52.52±0.85	14.65±0.15	66.17	12.35
Maras-10	7.57±0.18	2.81±0.23	28.32±0.54	50.27±0.76	10.56±0.22	60.83	11.05
Maras-18	5.79±0.03	3.41±0.35	28.26±0.52	53.23±1.01	8.99±0.21	62.22	9.90
Maras-19	6.35±0.25	2.98±0.25	25.21±0.58	56.09±0.93	9.01±0.09	65.10	10.02

Values represent means of ± standard errors of three samples.
C 16 : 0, palmitic acid; C 18 : 0, stearic acid; C 18 : 1, oleic acid; C 18 : 2, linoleic acid; C 18 : 3, linolenic acid.
nd: not determined

The data indicate that among the two main saturated fatty acids, palmitic acid content was higher than stearic acid content of each cultivar analyzed. Palmitic and stearic acid contents ranged between 5.50–8.11% and 2.36–3.44%, respectively.

As a mono-unsaturated fatty acid, oleic acid content of walnuts ranged from 14.14–28.32%. Particularly, 'Maras-10' and 'Maras-18' had the highest oleic acid content among all the varieties analyzed.

Linoleic acid was found to be the main poly-unsaturated fatty acid in walnut kernels. In all analyzed varieties and genotypes linoleic acid accounted for more than 50% of the total fatty acid content. It ranged from 50.27% ('Maras-10')–64.42% ('Seker-2'). The polyunsaturated fatty acid (PUFA) content (18 : 2 + 18 : 3) of the total fatty acids ranged from 60.83–75.52% for the same genotypes. 6 out of 14 newly selected Turkish walnut varieties had more than 70% PUFA. These were 'Seker-2', 'Hidayet', 'Seker-3', 'Kaman', 'Akca 1' and 'Sutyemez-2'.

Total dietary fibre content of walnuts ranged from 9.83–12.59 g/100 g fresh weight basis. 'Seker-3' showed the highest dietary fibre content among all the others. Four new selected genotypes ('Seker-3', 'Sutyemez-1', 'Bursa-95' and 'Sebin') had higher dietary fibre contents than other popular international cultivars.

Range of fatty acid composition in our results was comparable to the data previously reported in literature[2, 3, 14, 18, 19]. However, the data indicate that some of the new genotypes are different from each other in the levels of individual fatty acids. These become important when selecting the cultivars for growing different commercial purposes. For instance, for long term storage purposes walnuts containing lower levels of poly-unsaturated fatty acids are desired. On the other hand, walnuts intended for healthy snack should contain higher polyunsaturated fatty acids and fibres.

Potential health benefits of newly selected Turkish walnut varieties have shown promising results since 6 out of 14 newly selected varieties had more than 70% PUFA and all the new selections except one had more than 10% dietary fibre content. Other than attractive pomological characteristics, higher levels of poly-unsaturated fatty acids and fibre contents may be more desirable among the consumers because of their potential health benefits.

Results and findings of the present study may help in the selection of cultivars that are useful for future commercial production in the region and may make a contribution to healthy diets.

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