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Fatty acid composition of some walnut (*Juglans regia* L.) cultivars from east Anatolia

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RESUMEN

Composición en ácidos grasos de cultivos de nueces (*Juglans regia* L.) del Este de Anatolia.

En este estudio se ha determinado la composición en ácidos grasos de diferentes cultivos de nueces (*Juglans regia* L.) producidos en Adilcevaz en el Este de Anatolia. El contenido de aceite total de las nueces osciló entre 65.00 ± 0.06 y 70.00 ± 0.58 %. El contenido en ácido oleico varió desde 22.63 a 27.27 % respecto a los ácidos grasos totales mientras que los contenidos en ácido linoleico y linolénico variaron desde 49.93 hasta 54.41 % y desde 14.32 hasta 17.82 % respectivamente. El contenido en ácido palmítico de las muestras de nueces estuvo comprendido entre 5.61 y 5.82 % mientras que de ácido miristico solo se encontraron trazas (< 0.1 %). Finalmente, los resultados de los ácidos grasos indicaron que los cultivos de nueces del Este de Anatolia son distintos en cuanto a su perfil de ácido linolenico. Estos resultados pueden ser significativos para estudios de selección en orden a identificar mejor las variedades de nueces para dietas saludables.

PALABRAS-CLAVE: Acido graso - Adilcevaz-Anatolia - Composición proximal - Nuez.

SUMMARY

Fatty acid composition of some walnut (*Juglans regia* L.) cultivars from east Anatolia.

In this study, the fatty acid composition of different walnut (*Juglans regia* L.) cultivars grown in Adilcevaz in east Anatolia was determined. The total oil content of the walnuts ranged from 65.00 ± 0.06 to 70.00 ± 0.58 %. The oleic acid content of the oils ranged from 22.63 to 27.27 % of the total fatty acids while the linoleic acid and linolenic contents ranged from 49.93 to 54.41 % and 14.32 to 17.82 % respectively. The palmitic acid content of the walnuts ranged from 5.61 % to 5.82 % while there was a trace amount of miristic acid (<0.1 %) in the samples. Finally, the fatty acid results indicated that walnut cultivars from east Anatolia were distinctive in terms of their linolenic acid profile. These results might be significant for selection studies in order to better identify walnut varieties for healthy diets.

KEY-WORDS: Adilcevaz- Anatolia - Fatty acid - Proximate composition - Walnut.

1. INTRODUCTION

Turkey plays an important role in walnut production in the world. Anatolia is ranked fourth in the world with 136 000 tonnes of walnut (*Juglans regia* L.) production (FAO, 2002). This production is mostly from seedling trees, but cultivation of new walnut cultivars from selective breeding programmes in Turkey leads to a standard walnut production (Koyuncu *et al.*, 2004; Seyhan *et al.*, 2002). In this respect, in Turkey the identification of walnut standard types has been developing and their production is being encouraged to increase the market share in the world.

Nowadays, consumers have been increasingly aware of the quality, nutritional composition and health-promoting components of foods. Walnuts, the seeds of the Juglandaceae tree, are a highly nutritious vegetable food, and they have been used traditionally to treat cough, stomachache and cancer in Asia and european countries (Fukuda *et al.*, 2003). Walnut kernels generally contain about 60 % oil (Prasad, 1994) but this may vary from 52 to 70 % depending on the cultivar, location of growth and irrigation state. Walnuts have generated considerable interest because they are believed to possess plasma cholesterol-lowering properties (Sabate *et al.*, 1993). This property is believed to result from the fatty acid profile present in walnut oil. The major fatty acids (FA) found in walnut oil are oleic (18:1 n-9), linoleic (18:2 n-6) and linolenic (18:3 n-3) acids. The ratios of these FA are considered important for their economic and nutritional value. For example, lower linoleic and linolenic acid contents in the oils may have a longer shelf life while higher levels of polyunsaturated fatty acids are more desirable because of their potential health benefits (Cunnane *et al.*, 1993, Abbey *et al.*, 1994). In one study, the supplementation of a background diet with 68 g of walnut/day reduced the total and low-density lipoprotein cholesterol by 5 and 9 % respectively, and it was suggested that these reductions would have some positive effects in reducing the risk of coronary heart disease (Abbey *et al.*, 1994). This is important as Greve *et al.* (1992) have shown that the fatty acid profile and chemical composition of walnut oil varies among cultivars. Another source of interest in the fatty acid profile of different walnut cultivars is based on the differences in flavor stability during storage. McNeil *et al.* (1994) have shown, using consumer taste tests, that locally grown cultivars have markedly

different organoleptic properties after only short-term storage of in-shell nuts in dry and cool conditions. The differences in flavor stability may depend on the relative amounts of fatty acids present in the different cultivars of the walnuts evaluated.

Adilcevaz is a small country in east Anatolia but is famous for its walnut variety and production. A walnut festival has been celebrated at every harvest period and an interesting walnut contest among the producers is organized. Adilcevaz also contributes an important portion to for the walnut production in Turkey.

The present study is a preliminary investigation of the fatty acid composition of different walnut cultivars grown in the Adilcevaz region of east Anatolia. These data may contribute to the studies for the selection of walnut cultivars in terms of healthy diets that are important for future commercial production in the region.

2. EXPERIMENTAL

Source of the walnut and sample preparation

Four different cultivars of walnut samples were obtained from native producers in Adilcevaz country (Van, east Anatolia). The four different walnut samples were selected according to their reputation in the region in terms of their botanical, sensory and size quality characteristics. Those walnut species were the winners in the regional walnut competition held the past year. The walnut samples (200) g were removed from packages and shelled to remove kernels. The walnut kernels (about 100 g) from each party were ground into a fine powder with a hand mortar. Then the oil was extracted from the kernels using cold ether extraction. The oils were placed in screw-capped test tubes and stored in the refrigerator (4 ^{o}C) until the analysis commenced the following day.

Proximate characteristics of walnuts

For the chemical analysis, each group of walnuts was homogenized thoroughly and than analyzed to determine moisture (by drying the ground nuts at 105^{o}C to a constant weight), fat (as an extractable component in Soxhlet apparatus) and protein (as crude nitrogen x 6.25), using standard methods (AOAC, 1995), ash (after dry 105 ^{o}C, and carbonizing first at 250 ^{o}C, then gradually ramping up the temperature to 450 ^{o}C overnight) (Dogan and Basoglu, 1985). All chemicals used in this study were supplied by Merck and Sigma Chemical companies, and all the analysis were performed in duplicate.

Fatty acid analysis

The fatty acid (FA) composition of the oils was determined by preparing methyl esters of the FA (AOAC 1990). The gas chromatography was a Shimadzu GC 40 A (Shimadzu, Kyoto, Japan) fitted with a 2.1 m spiral steel (SS) column, inner diameter (3.2 mm). Propped matter was chromosorb W (AW-DMCS) (60-80 mesh) and filling matter of the column was DECS (dietilenglicolsuksinate, 10 %), using nitrogen as the carrier gas (30 ml/min), hydrogen (28 ml/min) and air (220ml/min). The

Table 1
Proximate composition of the walnut kernels from Adilcevaz

Kernel characteristics	Varieties of walnuts				
		W_1	W_2	W_3	W_4
Oil extracted	[%]	69.00±0.58	70.00±0.58	65.00±0.06	69.00±0.58
Protein content	[%]	17.00±0.02	17.47±0.02	16.23±0.09	17.04±0.05
Moisture	[%]	3.35±0.06	3.50±0.02	3.46±0.03	3.00±0.09
Ash	[%]	2.19±0.01	2.26±0.01	1.90±0.01	1.93±0.01

Values represent means of duplicate value [dry weight].

W_1- W_4 : Walnut cultivars in east Anatolia

detector (FID) and injection temperatures were 250°C, and the column was maintained at 200 °C. The integrator used was Chromatopac CR 6 A (Shimadzu) with 5 mm/min. paper speed.

3. RESULTS

The total oil, protein, moisture and ash contents of the walnut kernels ranged from 65.00 ± 0.06 to 70.00 ± 0.58 %, 17.00 ± 0.02 to 17.47 ± 0.02 %, 3.00 ± 0.09 to 3.50 ± 0.02 % and 1.90 ± 0.01 to 2.26 ± 0.01 % respectively (Table 1). The fatty acid composition of the walnut oils from the Adilcevaz region in eastern Turkey is shown in Table 2. As seen from Table 2, the oleic acid content of the oils ranged from 22.63 to 27.27 % while the linoleic and linolenic acid contents ranged from 49.93 to 54.41 % and 14.32-17.82 % respectively. However, the palmitic acid content changed from 5.61 % to 5.82 %. As could be seen in Table 2, the major fatty acids in the walnuts were linoleic ($C_{18:2}$), oleic ($C_{18:1}$) and linolenic ($C_{18:3}$) acids and the polyunsaturated fatty acid contents ($C_{18:2}$ +$C_{18:3}$) of the total fatty acids ranged from 64.90 to 69.42 %. The highest linoleic acid content among the varieties was determined in W_3 while the lowest palmitic acid content was observed in the W_2 cultivar. Miristic acid was not determined in two of the samples but it was found in trace levels in samples W_1 and W_2. The statistical results revealed that there was no difference in the contents of palmitic acid and linoleic acid of different varieties (the difference was less than 10 %). On the other hand there were considerable differences among varieties in terms of stearic, oleic and linolenic acid contents; for example, the third variety contained more than 50 % of stearic acid compared to that of the first variety.

4. DISCUSSION

The results of this research are comparable to the data previously reported in the literature (Greve *et al.*, 1992; Garcia *et al.*, 1994; Beyhan *et al.*; 1995; Zwarts *et al.*, 1999). There was a variation among the varieties in terms of the fatty acid composition for walnuts grown in the Adilcevaz region. However, it was observed that oleic and linoleic acid profiles in the oil of walnuts grown in Adilcevaz were slightly higher than those of the walnut oils of european

Table 2
Contents of Fatty acid of the walnut oils from Adilcevaz East Anatolia

Fatty acids composition		**Varieties of walnuts**			
		W_1	**W_2**	**W_3**	**W_4**
$C_{14:0}$	[%]	0.19	0.06	N.D	N.D
$C_{16:0}$	[%]	5.82	5.61	5.79	5.68
$C_{18:0}$	[%]	1.90	2.16	2.85	2.04
$C_{18:1}$	[%]	22.67	27.27	22.63	23.08
$C_{18:2}$	[%]	51.60	49.93	54.41	52.57
$C_{18:3}$	[%]	17.82	14.97	14.32	16.63
$C_{18:2}$ +$C_{18:3}$	[%]	69.42	64.90	68.73	69.20

C_{14} :Miristic acid; %; $C_{16:0}$:Palmitic acid; $C_{18:0}$: Stearic acid;

$C_{18:1}$:Oleic acid; $C_{18:2}$:Linoleic acid; $C_{18:3}$:Linolenic acid;

$C_{18:2}$ +$C_{18:3}$: Polyunsaturated acid; N.D: Could not be detected,

W_1- W_4 : Walnut cultivars in east Anatolia

commercial cultivars and two US commercial cultivars, five New Zealand selections (Zwarts *et al*., 1999), but there was no difference in their linoleic acid contents. In a previous research, the FA composition of the oil from walnuts grown at Darende in eastern Anatolia were reported by Beyhan *et al*. (1995) in that research, the fatty acid composition of walnut oils were determined as palmitic acid 14.23 %, oleic acid 32.06 %, linoleic acid 37.63 % and linolenic acid 11.02 %. The data indicate that the walnut cultivars grown in Adilcevaz seem to be different from the levels of individual fatty acids (Savage *et al*., 1999; McNeil *et al*., 1994; Zwarts *et al*., 1999).

To our knowledge, these data represent the first fatty acid analysis carried out on Adilcevaz (East Anatolia) walnuts, and this is important to determine their nutritional value and their potential for commercial use. This might be important in selecting cultivars for particular uses; e.g. for the production of healthy snack foods high in polyunsaturated fatty acids. The variation in the fatty acid composition of the nuts from different cultivars may affect the final use of the product. For example, the nuts containing high levels of oleic, linoleic and linolenic acids should be preferred if the nuts were destinated for use in a cholesterol-lowering diet. There is no doubt that walnuts can contribute to a healthy diet. Sabate *et al*. (1993) showed that the inclusion of 84 g of walnuts per day in the diet of healthy men for a period of 8 weeks significantly reduced their blood cholesterol levels provided that their diets were adjusted to control their total fat intake.

5. CONCLUSION

The result of this research indicated that the chemical properties of different walnuts from Adilcevaz in east Anatolia were generally similar. In fact, the fatty acid composition had a slightly distinctive linolenic fatty acid profile, compared to the other cultivars known in the world. However, palmitic acid was present in low concentrations while there was a trace amount of miristic acid. This could be explained by the fact that ecological factors do not solely affect the composition of walnuts, genetic factors and horticultural applications might also be responsible for their composition. Finally, it might be recommended that W_1 and W_4 cultivars in east Anatolia should be selected in terms of their polyunsaturated fatty acid for human health.

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