Oil Characteristics of Iranian Walnuts

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ABSTRACT

Fatty acid composition, iodine value, refractive index, and saponification value of walnuts from six Iranian cultivars of *Juglans regia* grown in one region were determined. Results do not differ considerably, except for one cultivar. These data are compared with those reported in the literature for walnuts from other origins. Acidity and peroxide value of 4 and 9 month old walnuts also were determined. All samples had low acidity; but their peroxide values were rather high, and rancidity was organoleptically detectable in most cases.

INTRODUCTION

Fat characteristics and calculated fatty acid composition of walnut oils from various species are reported in general literature. Fatty acid composition of Persian walnut from origins other than Persia (Iran), recently have been studied (1-3) by newer methods. In this investigation, walnuts from six Iranian cultivars of *Juglans regia* L. are examined for their fatty acid composition, fat characteristics, and possible varietal differences. The acid and peroxide values of the oils extracted from 4 and 9 month old walnuts also are determined to find out the extent of their sensitivity toward fat deterioration under normal storage conditions.

MATERIALS AND METHODS

Six single walnut trees, each from a different cultivar grown in same region, were selected. The nuts of each tree were collected and kept separately as representative samples of the respective cultivar. After harvesting, their green hulls were removed. The nuts were dried in sunshine and stored at room temperature (18-23 C). They were shelled just before kernels were needed for examination.

To determine the ratio of kernel to whole nut, four 200 g portions from each cultivar were weighed. After shelling, the shells and kernels of each portion were weighed separately.

The moisture content of kernels was determined according to method I.B.1 of the International Union of Pure and Applied Chemistry (4) with some modifications.

For determination of oil content, ground dried sample was extracted with petroleum ether in a Soxhlet apparatus for 4 hr. The residue was ground again and extracted once more overnight. The extracts were combined and the ether was removed in a Büchi vacuum distillation apparatus. The remainder was dried at 103 ± 2 C for 20 min, cooled in desiccator, and weighed.

Fresh oils, extracted from kernels of 4 and 9 month old nuts with ethyl ether by short time extractions, were examined for acidity and peroxide value according to AOCS methods Ca 5a-40 and Cd 8-53 (5).

Saponification value also was determined according to AOCS method Cd 3-25 (5). Refractive index was determined with a Zeiss-Abbe refractometer at 40 C. Determination of iodine value (Hanus method) and unsaponifiable matter, as well as the preparation of fatty acid methyl esters were carried out according to Association of Official Analytical Chemists' methods 28.016, 28.63, and 28.58 (6), respectively.

Analysis of fatty acid methyl esters was carried out by gas liquid chromatography (GLC) on a 2 m x 4 mm inside diameter copper column packed with 20% diethyleneglycol succinate on Chromosorb W, 60-80 mesh. Temperatures used were: 190 C for column and 200 C for inlet and detector ovens. Flow rates were: 15 ml/mN_2 as carrier gas and 35 ml/m H_2 with 350 ml/m air for flame.

RESULTS AND DISCUSSION

Local names and some characteristics of walnuts from the six examined Iranian cultivars are shown in Table I. The ratio of kernel to whole nut varied from 42.3-58.6% in different cultivars. Their kernels did not show considerable difference in their oil content (63.5-68.4%). The results with an average of 66.5% were slightly higher than what is reported generally for walnuts (7-9). The oil content of the nuts were in the range of 28.8-39.4%.

Due to effective sunshine drying, the walnut kernels contained low moisture (2.0-3.2%) which explains the low acid values (Table II) determined in 4 month (0.028-0.059%) and 9 month (0.055-0.087%) old nuts. They were much lower than those found by other workers (10) in good quality kernels. The rather high peroxide values (Table II), ranging from 1.34-4.49 in 4 month old and from 5.25-10.41 in 9 month old nuts indicated high sensivity of walnut kernel to fat oxidation. Rancidity was organoleptically detectable in most cases, and they could not be considered as first grade walnuts any longer (10). Only 4 month old nuts of nos. 2, 3, and 5 were acceptable. Improved storage conditions are needed if walnuts are to be kept for a long time.

Additional data for oils from the 4 month old nuts are given in Table III. Unsaponifiable matter varied from 0.33% in no. 6 to 0.90% in no. 1, showing a wider range than those found in the literature (7-9). The results obtained for saponification value (189.8-191.7), iodine value (123.8-140.3), and refractive index (1.4670-1.4690) were mostly lower than the lowest values reported in general literature (7-9, 11,12). In the walnut oils of the Iranian cultivars, palmitic (6.3-8.2%), stearic (0.8-2.2%), oleic (24.1-39.2%), linoleic (42.5-56.6%), and linolenic (8.4-13.4%) acids were the main fatty acids measurable by GLC analysis under previously mentioned conditions. In a

TABLE I

Persian Walnut Cultivars and Their Oil Content

Cultivar no.	Local name	Kernel/nut %	Oil/kernel %	Oil/nut %
1	Magh zee	50.3	63.5	31.9
2	Da ma dee	57.6	68.4	39.4
3	Ca gha zee	58.6	66.3	38.7
4	Soo za nee	49.3	67.2	33.1
5	Com boo zeh ee	42.3	68.2	28.8
6	Ma coo ee	58.0	65.2	37.8

TABLE II

Data Concerning Keeping Quality of Walnuts

Cultivar no.	4 Month old nuts			9 Month old nuts	
	Moisture/kernel %	Peroxide value m Eq/Kg	FFA[a] %	Peroxide value, m Eq/Kg	FFA[a] %
1	2.0	4.49	0.035	9.92	0.075
2	2.8	2.40	0.032	6.86	0.058
3	2.5	1.34	0.029	8.20	0.055
4	3.2	3.20	0.059	7.41	0.087
5	2.6	1.70	0.028	5.25	0.055
6	2.7	3.48	0.059	10.41	0.060

[a]Calculated as oleic acid. FFA = free fatty acid.

TABLE III

Fat Characteristics of Walnuts from Six Iranian Cultivars

Cultivar no	Experiment[a]	Unsaponifiable matter, %	Saponification value	Iodine value	$n_D^{40°}$	Fatty acid composition (wt %)				
						$C_{16:0}$	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$	$C_{18:3}$
1	A	0.90	191.7	135.7	1.4677	8.0	1.3	25.5	55.2	10.0
	B			132.1	1.4680	7.7	1.0	26.9	54.4	10.1
2	A	0.41	189.8	140.3	1.4690	7.1	1.8	25.1	52.5	13.4
	B			139.2	1.4688	8.2	2.2	24.1	53.8	11.8
3	A	0.65	190.9	134.0	1.4675	7.2	2.2	27.3	51.4	11.9
	B			135.2	1.4677	6.5	1.1	31.4	47.7	13.4
4	A	0.39	191.1	134.0	1.4675	7.6	1.9	29.8	48.6	11.9
	B			131.5	1.4677	7.9	1.8	30.4	46.5	13.3
5	A	0.41	191.4	128.7	1.4676	6.3	1.3	34.8	48.3	9.3
	A′					6.3	1.6	34.4	48.6	9.0
	B			123.8	1.4670	6.8	1.8	39.2	42.5	9.7
	B′					6.9	2.0	38.2	43.4	9.5
	B″					6.7	1.5	38.6	43.3	9.9
6	A	0.33	190.3	133.0	1.4673	6.7	0.8	27.6	56.6	8.4
	B			135.7	1.4677	7.0	1.8	27.5	54.1	10.4

[a]Two samples (A and B) were analyzed for each cultivar. Further analyses were made for cultivar 5, as explained in the text.

recent study (1), several fatty acids, other than those mentioned above, 26, comprising less than 0.1% of the total, were detected. In this investigation, however, only traces of components with retention times similar to those of myristic, palmitoleic, arachidic, and arachidonic were detected in most cases. Because of negligibility of these minor components, the fatty acid composition was normalized on the measurable components. The fatty acid composition of the Iranian cultivars was somewhat different from those reported elsewhere (1-3, 7, 8, 11,12). The results obtained for oil characteristics of the various Iranian cultivars did not show significant differences, except for no. 5. This cultivar showed somewhat different characteristics, especially in experiment B. To ascertain that the differences in fatty acid compositions were not due to experimental errors, the GLC analysis was run in duplicate in both experiments of no. 5. In addition, the oil extracted from no. 5B was methylated once more and analyzed by GLC. The results are given under 5B″ in Table III. They confirmed those of no. 5B. However, further studies are needed to find out if these differences are due to cultivar or other factors.

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