Characteristics of Iranian Almond Nuts and Oils

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ABSTRACT

Almonds of nine different Iranian cultivars were studied. The characteristics of almond nuts and almond oils from these cultivars were determined. They also were studied for possible deterioration of their oils during long storage time. Almond nuts from some cultivars showed significant differences. The variations found in the oil characteristics of different cultivars are not definitely due to varietal differences. The majority of these data does not agree with that found in literature. Acid and peroxide values are very low in both 3 and 12 month old samples, proving the good keeping quality of almonds with regard to their oil content.

INTRODUCTION

Almond tree, *Amygdalus Communis L.* (*Prunus amygdalus Stokes*), is distributed widely in many areas of Iran. There are several cultivars with various botanical features and different economical values. It is, therefore, important to establish their botanical characteristics, to see if they show significant varietal differences, and to examine their lipids to find out if the results agree with those reported in literature (1-7) for almonds of other origins.

Since almond nuts or kernels are often stored for several months before consumption, the samples of nine cultivars obtained from one region also were examined for their stability to fat deterioration under normal storage conditions.

MATERIALS AND METHODS

Three 200 g nut samples of each of the 9 almond cultivars were counted and shelled. The shells and kernels were weighed separately, and the wt of 100 nuts, as well as the ratios of kernel to whole nut, were calculated.

The moisture contents of kernels were determined according to the combined methods of AOCS (8) and the International Union of Pure and Applied Chemistry with some modifications. Kernels (50 g) were weighed and ground to coarse particles in a mortar. This was transferred to a drying dish; particles and oil remaining on the pestle and in the mortar were washed with petroleum ether and added to the ground sample. The combined sample was dried in an air-forced oven at 103 ± 2 C for 3 hr, cooled in a desiccator, and weighed. The dried sample was ground once more, dried again for 1 hr, cooled, and weighed. This was repeated enough times until the difference between 2 successive weighings was less than 5 mg.

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

Refractive index (n_D) was determined with a Zeiss-Abbe refractometer at 40 C. Determination of unsaponifiable matter, iodine value, as well as the preparation of fatty acid methyl esters, was carried out according to Methods 28.63, 28.016, and 25.58 of the Association of Official Analytical Chemists (10).

In cultivars no. 1-no. 5, two different samples were examined for their fatty acid composition.

TABLE I

Characteristics of Different Almond Nuts

No.	Local name	Wt of 100 nuts g	Oil/kernel %	Oil/nut %
1	Ma ma ee	519.6	60.0	20.4
2	Mo heb alee	199.1	61.4	35.3
3	Ta je ree	475.4	58.7	12.7
4	Mo na gha (*fragilis*)[a]	194.1	55.4	31.7
5	Pas ta ee	230.2	61.3	18.0
6	Haj Mir za ee	484.1	54.8	18.4
7	Sa fa ree	279.1	61.7	20.4
8[b]	Ma ma ee	276.4	45.9	14.7
9[b]	Kad kho da ee	214.0	57.6	31.3

[a]Except for no. 4, the other cultivars have no scientific names.
[b]Nos. 8 and 9 have bitter kernels.

Analysis of methyl esters of fatty acids was carried out by gas liquid chromatography (GLC) on a 4 mm inside diameter x 2 m copper column packed with 20% diethylene glycol succinate on Chromosorb W-A W 60-80 mesh. Temperatures used were: 190 C for column and 200 C for inlet and detector ovens. Flow rates were: 15 ml/m N_2 as carrier gas and 35 ml/m H_2 with 350 ml/m air for flame.

Acid (free fatty acid) and peroxide values were determined in fresh oils extracted from kernels of 3 or 12 month old nuts, according to Methods Ca 50-40 and Cd 8-53 of AOCS.

RESULTS AND DISCUSSION

Some botanical characteristics of almond nuts from the nine cultivars are presented in Table I. Whereas botanical features of almond nuts such as their size and shape, shell hardness, the ratio of kernel to whole nut (21.7-57.3%, calculated from columns 4 and 5 of Table I), and the wt of 100 nuts (194.1-519.6 g) compose varietal characteristics and may show significant differences in various cultivars, the oil content of the kernels does not differ considerably, except for cultivar no. 8 which is much lower (45.9%) than those of the others (55.4-61.7%).

Unsaponifiable matter (0.45-0.67%), refractive index (1.4617-1.4636), and iodine value (90.1-97.6) of the samples are shown in Table II. Not all of the results obtained for these almonds fall within the respective limits reported in literature (1-5). The variation in fatty acid composition (Table II) of the samples also did not agree with what is reported in the literature (1-4) for almonds from other origins. The Iranian almond oils showed lower content of myristic (only trace) and stearic (0.4-1.4%) acids and higher content of palmitic acid (6.0-8.1%). They were different in their content of oleic (67.6-80.8%) and linoleic (11.9-24.4%) acids. A component with retention time similar to that of palmitoleic acid was detected in measurable amounts (0.4-1.9%). No other fatty acid could be detected. The differences existing between fatty acid composition of each two samples of a single variety were low in most cases, but the results obtained for various cultivars differed significantly in some cases. Further studies are needed to clarify if the existing differences are due to varietal difference or other factors.

In Table III, all samples showed very low acid values (0.021-0.060%), due to low moisture contents of the kernels (2.7-4.6%). The peroxide values were also very low

TABLE II

Characteristics of Different Almond Oils

No.	Unsaponifiable %	n_D^{40}	Iodine value	Composition of fatty acids (Wt, %)[a]				
				$C_{16:0}$	$C_{16:1}$[b]	$C_{18:0}$	$C_{18:1}$	$C_{18:2}$
1	0.45	1.4624	94.7	6.0	0.7	1.0	73.1	19.2
				8.1	1.2	1.0	68.5	21.3
2	0.62	1.4628	96.8	7.8	1.9	1.4	68.7	20.2
				7.1	1.3	0.4	72.2	19.0
3	0.53	1.4626	95.9	7.7	0.8	0.8	71.9	18.9
				8.1	0.7	0.5	72.9	17.8
4	0.51	1.4632	97.4	6.6	0.8	1.1	67.6	23.9
				6.7	0.5	0.6	67.9	24.4
5	0.67	1.4623	94.1	6.9	0.5	0.6	74.3	17.5
				7.7	0.6	0.6	73.5	17.6
6	0.56	1.4629	95.5	7.1	0.5	0.6	73.3	18.5
7	0.46	1.4617	90.1	6.5	0.5	0.5	80.8	11.9
8	0.50	1.4636	97.6	7.3	0.6	0.7	73.7	17.7
9	0.57	1.4633	95.8	6.5	0.4	0.5	70.4	22.3

[a]Traces of $C_{14:0}$ were detected in some of the oils.

[b]The component had a retention time similar to that of palmitoleic acid ($C_{16:1}$).

TABLE III

Data Concerning Keeping Quality

No.	Storage time months	Moisture % of kernel	Free fatty acid[a] % of oil	Peroxide value meq/Kg oil
1	12	3.6	0.02	0.0
2	12	3.1	0.04	0.0
3	12	3.7	0.03	0.0
4	12	3.4	0.04	0.0
5	12	3.6	0.04	0.0
6	3	3.9	0.03	0.3
7	3	2.7	0.03	0.2
8	3	4.3	0.02	0.4
9	3	4.6	0.06	0.4

[a]Calculated as oleic acid.

(0.00-0.39 meq/Kg oil) in both 3 and 12 month old nuts, proving the good stability of their lipid content under normal storage conditions.

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[Received March 4, 1974]