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Composition and Characteristics of Some Seed Oils

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Physico-chemical characteristics and fatty acid composition of some seed oils (corn, cotton, olive, poppy, pumpkin, rape, safflower, sunflower, tea seed, walnut and wheatgerm) were determined. The oil content of samples ranged from 10.73 % (wheatgerm) to 61.3 % (walnut). Refractive index, relative density, saponification and iodine values were determined in the seed oils. The main fatty acids identified by gas chromatography were palmitic acid, oleic acid and linoleic acid. The linoleic acid content of oils were found high compared with other acids.

Key Words: Seeds, Oil, Physico-chemical properties, Fatty acids.

INTRODUCTION

Lipids have important use in all cells as structural components. The nutritional interest in the lipid compositions of vegetable oils has been rapidly increasing in recent years[1]. Camellia tea seeds have been utilized for more than a thousand years. Tea oil is a high quality cooking oil, like olive oil and it stores well at room temperature. Tea oil is a good raw material for industrial use and is used to manufacture soap, margarine, hair oil, lubricants, paints and in rustproof oil[2]. Wheat germ is one of the most nutritional products. Its oil is a highly rich unrefined oil that is one of the richest sources of vitamin A, D and E[3,4]. Plant seeds are important sources of oils of nutritional, industrial and pharmaceutical importance. The suitability of an oil for a particular purpose, however, is determined mainly by its fatty acid composition. This necessitates the search for new sources of novel oils[5,6]. The study of oil seeds for their minor constituents is useful in order that both the oil and its minor constituents be used effectively[6]. Some seed oils are already used for several purposes: blending highly saturated edible oils to provide new oils with modified nutritional values, as ingredients in paint and varnish formulations, surface coating and oleo-chemicals and as oils for cosmetic purposes[7]. To achieve the most economical and efficient utilization of these seeds, more information on the varieties, properties and composition is required.

Therefore, the present study attempts to establish the composition of these seeds belonging to several families with respect to physico-chemical properties and fatty acid content.

EXPERIMENTAL

Oil-bearing materials (corn, cotton, olive, poppy, pumpkin, rape, safflower, sunflower, tea seed, walnut and wheatgerm) were collected from plants growing in Konya provinces in Turkey in October 2009. Samples were transported to the laboratory in polypropylene bags and held at room temperature. They were cleaned and dried to a constant weight at room temperature for analysis. Prior to chemical analysis, samples were ground to pass a 0.5 mm screen. The ground samples were then packed in new plastic bags and stored in a desiccator until analysis.

Method: The chemical and physical properties (relative density, refractive index, iodine value, saponification number) were analyzed according to AOAC[8] methods. The oil was extracted with diethyl ether (50 ºC) in a Soxhlet apparatus. The extract was evaporated in vacuum. The lipid extract was collected in a flask. The extracted lipid was weighed to determine the oil content and stored under nitrogen at 4 ºC for further analyses.

Determination of fatty acids: Fatty acids were derivatised using the boron trifluoride method[9]. The working conditions of gas chromatography were as follows. Instrument: Varian 2100. Constant phase:10 % DEGS (diethylene glycol succinate) + 1 % H_3PO_4. Support matter: Chromosorb G (100/120 mesh). Column: stainless steel (190 cm length × 0.2 µm i.d.). Detector: FID (flame ionization detector). Temperatures: column: 200 ºC. Injector: 225 ºC. Detector : 225 ºC. Flow rates: Carrier gas (N_2): 6 mL/min. Burnt gas (H_2): 40 mL/min. Dry gas (O_2): 60 mL/min. Injection amount : 5 µL.

The fatty acids were converted to their methyl esters by heating in 10 % BF_3[10]. Commercial mixtures of fatty acid methyl esters were used as reference data for the relative retention times[8]. Results are given as mean values of two replicates.

Statistical analyses: Results of the research were analyzed for statistical significance by analysis of variance[11]. This research was performed by three replicates with a replicate.

RESULTS AND DISCUSSION

The physico-chemical properties of some seed oils (corn, cotton, olive, poppy, pumpkin, rape, safflower, sunflower, tea seed, walnut and wheatgerm) are given in Table-1.

The oil contents of materials varied from rice wheatgerm (10.3 %) to walnut (61.3 %), in decreasing order tea seed (54.0 %), pumpkin (44.7 %) poppy (38.0 %), sunflower (37.0 %), safflower (32.0 %). Wheatgerm contains about 8-14 % oil (average 10 %)[3,4]. The crude oil contents were simlar to those for caperberry seeds reported by Akgül and Özcan[12] and Özcan and Akgül[13].

The oils had a relative density between 0.8987 (poppy) to 0.9241 (safflower), lower than the value reported by Akgül and Özcan[12] for caper oil (1.0840-1.1045). Generally, mean values were 1.4688-1.4940 for refractive index, 114.0-197.0 for saponification value in all samples. Iodine values of oils were found in the range of 85-150. The observed saponification values of all material are 114-198, respectively.

The fatty acid composition of all-bearing material was determined by gas chromatography (Table-2). Linoleic acid (11.7-74.9 %) was present in the highest concentration, followed by oleic acid (14.9-76.7 %) and palmitic acid (3.2-21.0 %). Stearic acid and linolenic acid were present in low amounts. Pumpkin seeds oil with greater than 60 % linoleic acid has been previously reported for a few cultivars[14-16]. Palmitic acid, stearic acid, oleic acid, linoleic acid and linolenic acid contents of walnut oil were established as 7.22, 1.07, 28.51, 52.46 and 10.50 %, respectively[17]. Özkan and Koyuncu[18] found that the contents of the main fatty acids of walnut genotypes were 5.24-7.62 % palmitic acid, 2.56-3.67 % stearic acid, 21.18-40.20 % oleic acid, 43.94-60.12 % linoleic acid and 6.91-11.52 % linolenic acid. Zwarts *et al.*[19] reported as 6.7-8.2 % palmitic acid, 1.4-2.5 % stearic acid, 13.8-33.0 % oleic acid, 49.3-62.3 % linoleic acid and 8.0-14.2 % linolenic acid. The main fatty acids identified by gas chromatography were palmitic acid (6.4 %) oleic acid (13.4 %), linoleic acid (55,3 %) and linolenic acid (8.7 %)[20]. Tsevegsuren *et al.*[21] established 12.0-60.0 % oleic acid, to 22 % linoleic acid and 8.4-11.9 % linolenic acid in some rapeseed cultivars in Mongolia. Gül *et al.*[22], determined 56.92-65.71 % oleic acid and 9.55-11.97 % linolenic acid in winter rapeseed grown in Çanakkale province in Turkey. Przybylski and Mag[23] reported that canola oil contained 3.6 % palmitic acid, 1.5 % stearic acid, 61.6 % oleic acid, 21.7 % linoleic acid and 9.6 % linolenic acid. Wheatgerm oil contained 16.72 % palmitic acid, 15.79 % oleic acid, 60.23 % linoleic acid and 6.20 % linolenic acid[24]. Mazhidov *et al.*[25], determined oleic acid and linoleic acid as dominant fatty acids in wheatgerm flake oil. Rajaei *et al.*[26], established 15.8-21.5 % palmitic acid, 1.5-2.4 % stearic acid, 36.9-49.4 % oleic acid and 14.6-21.7 % linoleic acid in tea seed oil. Mannina *et al.*[27], found that the contents

TABLE-1
PHYSICAL AND CHEMICAL PROPERTIES OF SOME OIL-BEARING MATERIAL AND OILS

Materials	Oil content	Refractive index (n20/D)	Relative density (g/mL)	Iodine value	Saponification value
Sunflower	37.0* ± 1.3**	1.4738 ± 0.0012	0.9194 ± 0.005	139.2 ± 1.1	188.2 ± 0.4
Safflower	32.0 ± 1.7	1.4751 ± 0.0019	0.9241 ± 0.001	150.1 ± 3.2	196.4 ± 0.2
Cotton	18.0 ± 1.2	1.4728 ± 0.0018	0.9134 ± 0.003	107.3 ± 3.1	190.1 ± 0.3
Poppy	38.0 ± 2.3	1.4704 ± 0.0015	0.8987 ± 0.009	133.2 ± 2.7	197.3 ± 0.1
Wheat germ	11.3 ± 0.9	1.4713 ± 0.0013	0.9227 ± 0.007	108.4 ± 3.1	187.7 ± 0.7
Pumpkin	44.7 ± 2.4	1.4731 ± 0.0013	0.9192 ± 0.004	119.1 ± 2.3	184.4 ± 0.1
Walnut	61.3 ± 1.7	1.4715 ± 0.0023	0.9174 ± 0.009	115.3 ± 1.3	114.6 ± 0.5
Corn	10.3 ± 0.8	1.4940 ± 0.0015	0.9180 ± 0.003	118.1 ± 3.2	189.3 ± 0.7
Rape	39.0 ± 1.5	1.4701 ± 0.0017	0.9103 ± 0.005	108.4 ± 3.8	180.2 ± 0.4
Olive	27.0 ± 1.3	1.4688 ± 0.0015	0.9150 ± 0.007	86.3 ± 2.3	196.3 ± 0.6
Tea seed	54.0 ± 2.4	1.4701 ± 0.0013	0.9191 ± 0.005	88.1 ± 3.1	194.2 ± 0.1

*Mean, **Standard deviation.

TABLE-2
FATTY ACID COMPOSITION OF SOME SEED AND KERNEL OILS (%)

Materials	Myristic acid	Palmitic acid	Stearic acid	Oleic acid	Linoleic acid	Linolenic acid
Sunflower	0.2	6.3	4.7	23.2	37.9	0.20
Safflower	0.1	7.8	3.9	21.7	74.9	0.13
Cotton	0.7	21.0	2.1	26.0	47.0	0.71
Poppy	0.7	9.2	2.3	28.3	58.7	5.10
Wheat germ	0.6	12.7	0.8	26.3	57.3	3.80
Pumpkin	0.6	8.7	10.1	14.9	61.3	1.20
Walnut	0.8	5.8	2.4	23.7	52.9	4.20
Corn	0.1	10.8	5.4	38.3	37.6	1.00
Rape	1.2	3.2	1.2	47.3	28.4	4.70
Olive	0.1	10.9	3.1	76.7	11.7	1.10
Tea seed	0.4	18.7	1.8	43.7	16.8	0.40

of the main fatty acids of olive oil and hazelnut oil were 10.0-15.0/5.1-6.4 % palmitic acid, 1.7-3.2/2.2-2.5 % stearic acid, 67.1-76.2/77.8-84.2 % oleic acid, 6.8-16.6/6.4-12.0 % linoleic acid and 0.59-0.74/0.10-0.18 % linolenic acid, respectively. The linoleic acid content was lower (except for grape) than that of walnut (56-59 %)[28].

As a result, the differences in physical properties of seed and oils were probably due to environmental conditions in conjunction with analytical methods used. In addition, crude protein, crude fibre and crude oil contens of seeds affected chiefly by variety and growth conditions. It was also considered that biochemical differences of the varieties consisted of genetic variation and different ripening harvest time. It may be concluded that these seed oils are suitable for edible purposes as it contain relatively higher amounts of unsaturated fatty acid, very close to those reported for the edible oils. Future studies could include amino acid contents and functional properties of these oils.

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