

# Fatty Acid Composition and Tocopherol Contents of some Sesame Seed Oils

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**ABSTRACT:** *In this study, the oil contents, fatty acid composition and tocopherol contents of sesame seed and oils belong to different countries were determined. The oil contents of materials changed between 49.22% (India) and 56.16% (Nigeria-Kanu). The major saturated fatty acids in sesame seed oils were palmitic (6.06-9.03%), stearic (5.29-6.42%) acids with small 20:0 (0.19-0.71%) acids. The main unsaturated fatty acids of sesame oil samples were linoleic (38.11-47.11%) and oleic (36.83-44.49%) acids. There was a significant difference in the amounts of the major fatty acids in the oil samples ( $P < 0.05$ ). The oils extracted from the Sesamum seeds were composed of 18.51-49.63 mg /100g  $\gamma$ -tocopherol, 0.134 mg/100g  $\alpha$ -tocotrienol (India) and 0.415 mg/100g  $\gamma$ -tocotrienol (India). Total contents of tocopherol of samples ranged from 18.508 mg/100 g (Nigeria (Benue)) to 49.630 (Turkey (Mersin)).*

**KEYWORDS:** *Sesame seed; Oil; Fatty acid; Tocopherol;  $\gamma$ -tocopherol; GC; HPLC.*

## INTRODUCTION

Sesame (*Sesamum indicum* L.) is one of the most important oilseed crops world wide [1,2]. Sesame seed, an oilseed plant of the Pedaliaceae family, is cultivated on a worldwide basis for both oil and protein. Sesame seeds are used in the making of tahin and halva (sweet), and for the preparation of rolls, crackers, cakes and pastry products in commercial bakeries [1,3-4]. The sesame oil is an excellent edible oil that has high preservative qualities. It prevents rancidity, even though the seeds are prone to rancidity, the oil is resistant to oxidation and this is because of the natural preservative within the oil called sesamol [5-7]. The chemical

composition of sesame shows that the seed is an important source of oil (44-58%) and protein. In general, sesame oil contains oleic (35.9-47%), linoleic (35.6-47.6%), palmitic (8.7-13.8%), stearic (2.1-6.4%), as well as arachidic acids (0.1-0.7%) [4,8-10]. Sesame is called the “Queen of the oilseeds crops” because of its high oil yield, mildness and pleasant taste [11]. So, it is one of the most ancient oilseed crops known to mankind. The purpose of the present study was to assess the oil contents, fatty acid composition and tocopherol contents of sesame seed and oils belong to different countries.

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## EXPERIMENTAL SECTION

### Material

Sesame seed samples were provided from Gesaş A.Ş Industry in Turkey. After dried, seeds were transported to the laboratory. Seeds were transported to the laboratory in polypropylene bags and held at the refrigerator. They are cleaned in an air screen cleaner to remove all foreign matter such as dust, dirt and immature and broken seeds were discarded as well. The seeds were dried in an electric oven at 40 °C until a constant weight was reached, and then the seeds were packaged and stored at 4 °C till analyses. Seeds were preserved until ground using a hummer mill.

### Reagents

Petroleum ether (40-60 °C) was of analytical grade (Merck, Darmstadt, Germany). Heptane and tert-butyl methyl ether were of HPLC grade (Merck, Darmstadt, Germany). Tocopherol and tocotrienol standard compounds were purchased from CalBiochem (Darmstadt, Germany). Betulin,  $\beta$ -sitosterol, campesterol, and stigmasterol were obtained from Aldrich (Munich, Germany).

### Oil content

About 2 g of the seeds were ground in a ball mill and extracted with petroleum ether in a Soxhlet apparatus for 6 h. The solvent was removed by a rotary evaporator at 40 °C and 25 Torr. The oil was dried by a stream of nitrogen and stored at -20 °C until used.

### Fatty Acid Composition

One drop of the oil was dissolved in 1 mL of *n*-Heptane, 50  $\mu$ g of sodium methylate was added, and the closed tube was agitated vigorously for 1 min at room temperature. After the addition of 100  $\mu$ L of water, the tube was centrifuged at 4500 g for 10 min and the lower aqueous phase was removed. Then 50  $\mu$ L of HCl with 1 mol methyl orange was added, the solution was shortly mixed, and the lower aqueous phase was rejected. About 20 mg of sodium hydrogen sulphate (monohydrate, extra pure; Merck, Darmstadt, Germany) was added, and after centrifugation at 4500 g for 10 min, the top *n*-heptane phase was transferred to a vial and injected in a Varian 5890 gas chromatograph with a capillary column, CP-Sil 88 (100 m long, 0.25 mm ID, film thickness 0.2  $\mu$ m).

The temperature program was as follows: from 155 °C; heated to 220 °C (1.5 °C/min), 10 min isotherm; injector 250 °C, detector 250 °C; carrier gas 36 cm/s hydrogen; split ratio 1:50; detector gas 30 mL/min hydrogen; 300 mL/min air and 30 mL/min nitrogen; manual injection volume less than 1  $\mu$ L [12,13].

### Tocopherols

For determination of tocopherols, a solution of 250 mg of oil in 25 mL of *n*-heptane was directly used for the HPLC. The HPLC analysis was conducted using a Merck-Hitachi low-pressure gradient system, fitted with a L-6000 pump, a Merck-Hitachi F-1000 fluorescence spectrophotometer (detector wavelengths for excitation 295 nm, for emission 330 nm), and a D-2500 integration system. The samples in the amount of 20  $\mu$ L were injected by a Merck 655-A40 autosampler onto a Diol phase HPLC column 25 cm x 4.6 mmID (Merck, Darmstadt, Germany) used with a flow rate of 1.3 mL/min. The mobile phase used was *n*-Heptane/*tert*-butyl methyl ether (99+1, v/v [14].

### Statistical Analyses

All analyses were carried out three times and the results are mean  $\pm$  standard deviation of 11 independent sesame seed samples [15].

## RESULTS AND DISCUSSION

The oil contents of sesame seeds are given in Table 1. The oil contents of materials changed between 49.22% (India) and 56.16% (Nigeria-Kanu). According to literature values oil contents of sesame seeds were determined between 44% and 58% [2,4,8,16,17]. Sesame seed contains more oil than the major oilseeds, such as soybean, rapeseed-canola, sunflower seed, and cotton seed. The oil content of sesame seed varies with the variety of sesame and growing condition and location of sesame plants. Oil content was found to be influenced also by daily mean temperature and the cumulative degrees of daily temperatures during reproductive stage [18,19].

The fatty acid compositions of sesame samples are presented in Table 2. The major saturated fatty acids in sesame seed oils were palmitic (6.06-9.03%), stearic (5.29-6.42%) acids with small 20:0 (0.19-0.71%) acids. The main unsaturated fatty acids of sesame oil samples were linoleic (38.11-47.11%) and oleic (36.83-44.49%)

**Table 1: Oil contents of sesame seeds (%).**

Sesame seeds	Oil
Indian	49.22
Nigeria (Maidaguri)	51.44
Nigeria (Benue)	53.45
Burkina Faso	51.69
Uganda	53.89
Ethiopia (Humera)	50.14
Mozambik	51.37
Ethiopia (Voleqa)	50.43
Nigeria (Kanu)	56.16
Afganistan	54.54
Turkey (Mersin)	55.43
mean±standard deviation	52.52±2.29

**Table 2: Fatty acid composition of sesame seed oils (%).**

Seeds	Fatty acids										
	Palmitic	Palmitoleic	Stearic	Oleic	Trans-vaccenic	Linoleic	Linolenic	Arachidic	Eicosadienoic	Behenic	Lignoceric
Indian	9.01	0.14	5.41	40.88	0.89	42.13	0.30	0.64	0.20	0.14	0.10
Nigeria (Maidaguri)	8.77	0.11	5.81	39.52	0.86	43.25	0.40	0.67	0.19	0.15	0.10
Nigeria (Benue)	8.44	0.11	5.62	38.75	0.86	44.58	0.39	0.64	0.20	0.13	0.09
Burkina Faso	9.03	0.13	5.44	37.54	0.91	45.20	0.35	0.19	0.19	0.14	0.10
Uganda	7.55	0.10	5.78	39.37	0.77	44.77	0.38	0.65	0.19	0.14	0.10
Ethiopia (Humera)	8.47	0.10	6.14	38.73	0.80	44.01	0.38	0.68	0.20	0.14	0.10
Mozambik	8.16	0.10	5.29	36.83	0.82	47.11	0.36	0.64	0.19	0.15	0.10
Ethiopia (Voleqa)	7.94	0.09	5.84	38.52	0.77	45.16	0.40	0.67	0.20	0.15	0.10
Nigeria (Kanu)	8.85	0.13	5.33	37.29	0.91	45.88	0.37	0.62	0.20	0.14	0.09
Afganistan	6.06	0.11	6.42	44.49	0.79	38.11	0.31	0.71	0.22	0.14	0.10
Turkey (Mersin)	8.73	0.14	5.55	40.86	0.95	42.19	0.33	0.61	0.22	0.12	0.09
mean±standard deviation	8.27±0.87	0.11±0.02	5.69±0.35	39.34±2.15	0.86±0.06	43.85±2.42	0.36±0.03	0.61±0.14	0.20±0.01	0.14±0.01	0.10±0.01

**Table 3: Tocopherol contents of sesame seed oils (mg/100g).**

Seeds	$\alpha$ -tocotrienol	$\gamma$ -tocopherol	$\delta$ -tocotrienol	Total
Indian	0.134	27.365	0.415	27.91
Nigeria (Maidaguri)	-	18.915	-	18.915
Nigeria (Benue)	-	18.508	-	18.508
Burkina Faso	-	26.299	-	26.299
Uganda	-	22.425	-	22.425
Ethiopia (Humera)	-	22.201	-	22.201
Mozambik	-	25.624	-	25.624
Ethiopia (Voleqa)	-	22.368	--	22.368
Nigeria (Kanu)	-	32.115	-	32.115
Afganistan	-	20.507	-	20.507
Turkey (Mersin)	-	49.630	-	49.630
mean $\pm$ standard deviation	-	26.00 $\pm$ 8.80	-	26.05 $\pm$ 8.81

acids (Table 2). There was a significant difference in the amounts of the major fatty acids in the oil samples ( $P < 0.05$ ). The chemical composition of sesame seed varies with the variety, origin, color, and size of the seed [17]. Sesame seed oil can be classified in the oleic-linoleic the acid group [17]. Linoleic acid is one of the most important polyunsaturated fatty acids in human food because of its prevention of distinct heart vascular diseases [20]. The results obtained are in agreement with those of the literature [2,21]. In the previous study, sesame oil contained 11.2% palmitic, 41.9% oleic and 43.9% linoleic acid [16]. The main saturated fatty acids in sesame seed oil were palmitic (8.67%), stearic (5.56%) acids with small arachidic acid (0.8%) as illustrated by *Nzikou et al.* [2]. Unsaturated fatty acids have a favorable effect and positive health benefit than saturated fatty acids [22].

The tocopherol contents of most Sesame seed oils investigated in the present study has not been reported the previous literature. All the seed oils analysed exhibited differences in their tocopherol contents and the differences were found. The oils extracted from the *Sesamum* seeds were composed of 18.51-49.63 mg /100g  $\gamma$ -tocopherol, 0.134 mg/100g  $\alpha$ -tocotrienol (India) and 0.415 mg/100g  $\delta$ -tocotrienol (India) (Table 3). In other study, *Aued-Pimentel* [21] determined 0.24-36.0 mg/100g  $\alpha$ -tocopherol, 0.28-0.80 mg/100g  $\beta$ -tocopherol, 16-42mg/100g  $\gamma$ -tocopherol and 0.17-13.0 mg/100g

$\gamma$ -tocopherol in commercial sesame oil samples. The results showed partly similar to literature, especially as  $\gamma$ -tocopherol. Tocopherol contents in most seed oils could not be established. The results of the experiment presented here show that sesame seed oil have distinctive fatty acid and  $\gamma$ -tocopherol content profiles. Sesame seed can be a good source of oils due to the abundance of their high oil content. The oil exhibited good physicochemical properties and could be useful for industrial applications. Sesame seed oils are of an unsaturated type and contain mainly the fatty acids like oleic and linoleic. The oil can be classified in the oleic-linoleic acid group. The evaluation of the tocopherol profile of sesame oils could supply important information about the identity of the vegetable oils.

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