

# Fatty Acid Composition in the Seed Oils of *Papaver somniferum* from Different Provinces

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## Fatty Acid Composition in the Seed Oils of *Papaver somniferum* from Different Provinces

**Summary :** *Papaver somniferum* L. (*Papaveraceae*) is cultivated in Turkey for the production of Opium alkaloids in Bolvadin Opium Alkaloids factory and fixed oils of the seeds are consumed as edible oils in Anatolia.

In this study, the seeds oils were obtained from the seeds of eighty-three samples collected from ten provinces of Turkey. Methyl esters of fatty acids were prepared using Borontrifluoride-methanol reagent. Their analyses were performed by capillary gas chromatography system with Ultra I column using Helium as the carrier gas. According to the results, the main components of the oils have been determined as linoleic and oleic acids.

**Key Words:** *Papaver somniferum* L., Poppy, *Papaveraceae*, Fatty acids, Seed oil

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## Farklı Bölgelerden Toplanan *Papaver somniferum* Tohum Yağlarının Yağ Asitleri Bileşimi

**Özet :** *Papaver somniferum* L. (*Papaveraceae*) Bolvadin'de bulunan afyon alkaloidleri fabrikasında afyon alkaloidlerini elde etmek üzere kültürü yapılan ve tohum yağları yemeklik yağ olarak Anadolu'da tüketilen bir bitkidir.

Bu çalışmada, Türkiye'nin on farklı bölgesinden toplanan seksen üç örneğin tohum yağları elde edilmiştir. Yağ asitlerinin metil esterleri Borontriflorür-metanol reaktifi kullanılarak hazırlanmış ve kapiler gaz kromatografisi ile analizi yapılmıştır. Analizde Ultra I kolon ve taşıyıcı gaz olarak helyum kullanılmıştır. Sonuçlara göre yağların başlıca bileşenlerinin linoleik ve oleik asitler olduğu tespit edilmiştir.

**Anahtar kelimeler :** *Papaver somniferum* L., Haşhaş, *Papaveraceae*, Yağ asitleri, Tohum yağı

## INTRODUCTION

*Papaver somniferum* L. (Opium Poppy) is an annual herb with large, showy, solitary flowers varying in color from white to pink or purple. The color of its seeds is also variable, ranging in color from blue-black or grey to yellow white or rose-brown<sup>1</sup>.

Opium poppy has three varieties. The poppy with white flowers and seeds is cultivated in India. The capsules are ovoid and devoid of pores. This variety is traditionally referred to as *album*. The black poppy is traditionally cultivated in Europe for seeds. The flowers are purplish and the seeds are slate grey.

The capsule is more globular than that of the white poppy and its dehiscences involves pores located under the stigmata. This variety is known as *nigrum*. The Asia Minor poppy has purple flowers and a wide globular capsule. The seeds are purplish-black. This variety is *glabrum*<sup>2</sup>. The cultivation of *Papaver somniferum* is controlled internationally by International Narcotics Control Board of the United Nations. The poppy has been grown in Anatolia since 3000 B.C.. Although initially free from any limitation, restrictions were imposed on poppy cultivation in 1993, as Turkey became party to the International Opium Convention. Control of production, purchase, stock, standardization and export of poppy straw, im-

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port and distribution of drugs for domestic medical requirements were carried out by the Turkish Grain and Opiates Board (TMO).

Since 1974, the newly introduced system provides a control mechanism covering all the phases of the cultivation. Cultivation can only be carried out under licence in considerably restricted areas using the unlanded method. Cultivation is carried out in 10 provinces of Turkey, harvested straws are separated from the seeds under inspection and the unlanded capsules are brought by the producers to the TMO<sup>3,4</sup>.

Oil is extracted from the seeds used for cooking and in paint industry. The seeds are also used in making bread, cakes and pastries and the residue of the seeds is used as animal fodder<sup>3</sup>.

*Papaver somniferum* seed oils were also used in medicine. For example; iodized poppy seed oil was used in deficiency of iodine. Hepatic artery injection of iodized oil mixed with various drugs is widely used for the treatment of liver tumors. Iodinated ethyl ester of poppy seed oil (Lipiodol Ultra-Fluid) was used in hepatocellular carcinoma. More recently, iodinated-131-labeled iodized oil (Lipicis) has been injected into the hepatic artery for interstitial radiation therapy. Some clinical success has been reported with this method in the treatment of hepatocellular carcinoma with portal vein thrombosis<sup>5</sup>.

There have been some studies on poppy seed oils in Turkey<sup>6,7</sup>. Demirbaş et al. used Soxhlet apparatus and acetone extraction method<sup>6</sup>. The amount and composition of the seed oils of the *Papaver orientale* which was cultivated in different provinces of Yugoslavia were analysed by gas chromatography. Linoleic and oleic acids were found as the major components in this plant<sup>8</sup>. The amount and composition of the seed oils of the *Papaver orientale* which was cultivated in different provinces of Yugoslavia were analysed by gas chromatography. Linoleic and oleic acids were found as the major components in this plant<sup>8</sup>.

In this study, we aimed to investigate the amount and composition of seed oils from this plant. The fatty acid composition of the seed oils extracted from the seeds of eighty three samples collected from different cultivated regions in Turkey was determined by GC.

## MATERIAL and METHODS

**Material:** The seeds of *Papaver somniferum* L. (Papaveraceae) were obtained from eighty-three cultivation sites belonged to ten provinces, namely Afyon (Başmakçı, Bayat, Bolvadin, Center, Çay, Çobanlar, Dazkırı, Dinar, Emirdağ, Evciler, Hocalar, İhsaniye, İscehisar, Sandıklı, Sincanlı, Sultandağı(1)-Doğancık, Sultandağı(2)-Yakasenek, Şuhut), Amasya (Center, Göynücek, Gümüşhacıköy, Merzifon), Burdur (Ağlasun, Bucak, Center, Çavdır, Çeltikçi, Gülhisar, Karamanlı, Kemer, Tefenni, Yeşilova), Denizli (Acıpayam, Baklan, Bekilli, Buldan, Center, Çal, Çardak, Çivril, Güney, Honaz, Serinhisar), Isparta (Center, Gelendost, Gönen, Keçiborlu, Şarkikaraağaç, Yalvaç), Konya (Adasız, Altınova, Derbent, Doğanhisar, Höyük, Ilgın, Kadınhanı, Selçuklu, Seydişehir, Tuzlukçu), Kütahya (Altıntaş, Aslanapa, Center, Domaniç, Dumlupınar, Emet, Gediz, Hisarcık, Pazarlar, Simav, Şaphane, Tavşanlı), Manisa (Kula, Selendi), Tokat (Artova, Erbaa, Turhal, Yurt), Uşak (Banaz, Center, Eşme, Karahallı, Sivasslı, Ulubey).

**Method:** Methyl esters of fatty acids in the oils were determined by capillary gas chromatography.

**Preparation of methyl esters of fatty acids:** Oils were extracted from the dried poppy seeds with petroleum ether (40-60°C) in Soxhlet apparatus. Thereafter, oils were saponified with 0.5 N sodium hydroxide and transesterified according to the method provided by Morrison<sup>9</sup>. 2 ml borontrifluoride-methanol reagent were added to the oils (10-15 mg) in petroleum ether. The mixture was heated in the boiling water bath for three minutes. The reaction was stopped by adding approximately 1 ml of water. After separation of the two layers, methyl esters of fatty acids (in petroleum ether) were obtained.

## Instrumentation

Methyl esters of fatty acids were analyzed by capillary GC Hewlett Packard Model 5890 gas chro-

matograph with flame ionization detector. The capillary column was Ultra 1 (cross linked methyl silicone gum phase (50 m x 0.2 mm x 0.33 µm). The temperature was programmed between 180-230 °C and rate was 2 °C per minute. Detector and injector temperatures were 250 °C, helium was used as carrier gas, flow rate was set at 0.9 ml/min. Split ratio was 1/50 and chart speed was 0.5 cm/min. for the first nine minutes and then 1 cm/min. Peaks were identified by comparing with standard samples and relative amounts of fatty acids were calculated by Integrator Hewlett Packard HP 3398-11.

## RESULTS and DISCUSSION

This is the first study about the seed oils of all *Papaver somniferum* varieties cultivated in our country. The seeds of *Papaver somniferum* L. (Papaveraceae) were obtained from eighty-three different cultivation sites belonged to ten provinces. The amount of the seeds and oils of these samples are indicated in Table 1.

Table 1. The seed and flower colors and amount of seeds and oils in the samples

Provinces	Cultivation Site (No)	Seed Color	Flower Color	Seed* (g)	Seed oil (%)
Afyon	18	Brownish	White	2.24-7.53	30.56-64.41
Amasya	4	Yellowish, grey	White	5.18-8.85	42.65-47.88
Burdur	10	Brownish	White	2.99-7.71	39.55-51.76
Denizli	11	Grey, lead colored	Purple	2.75-6.57	34.42-51.84
Isparta	6	Brownish	White	2.40-6.21	21.27-51.84
Konya	10	Yellowish	White	3.51-7.95	42.50-55.48
Kütahya	12	Grey, lead colored	Purple	3.77-7.32	35.13-53.17
Manisa	2	Grey	Purple	3.97-4.28	38.21-45.89
Tokat	4	Grey, lead colored	Purple	2.97-5.83	40.66-51.40
Uşak	6	Grey, lead colored	Purple	3.16-9.04	23.06-45.69

\* The amount of seed in one capsule.

According to the results shown in the Table 2 (a-j), all samples contained linoleic, oleic, palmitic, stearic, capric, elaidic and nonanoic acids. Linoleic acid was found as the major component of the oils. The other major components are oleic and palmitic acid.

Linoleic acid (18:2) and linolenic acid (18:3) are the most abundant essential fatty acids in the plants and recently, the oils which contain these fatty acids were used in the treatment of some diseases. Essential fatty acids (EFA) have been acted about cholesterol metabolism, transformation and change to metabolic products. Cholesterol and low density lipoprotein amounts in the persons who are nourished with too much EFA were decreased. Polyunsaturated fatty acids prevented atherosclerosis<sup>10,11</sup>. When oils which have unsaturated fatty acids were hydrogenated, coronary defects were increased<sup>12</sup>.

Linoleic acid is one of the essential fatty acids (EFA) and is a precursor of eicosapentanoic acid (20:5) which causes a diminuation in platelet aggregation and extension of the bleeding time.

The evening primrose (*Oenothera biennis* L.) is one of the rich sources in terms of linoleic acid and γ-linolenic acid used in patients against atopic eczema (13,14). In our study, we found linolenic acid in the oils obtained from Denizli (Honaz, Serinhisar) and Kütahya (Altıntaş, Tavşanlı) samples and similar activity, as the evening primrose oil can be expected.

Heptanoic acid and undecanoic acid were found in very little amounts or none at all. Palmitoleic acid was determined in samples from Afyon (Dazkırı, Center, Sultandağı (1), Sincanlı), Denizli (Buldan, Honaz), Konya (Derbent), Tokat (Turhal) and Uşak (Sivaslı).

These findings indicated that all samples contain about 44.6 % of a fixed oil (poppy seed oil). There is no large differences among the oils. All the oils can be used in the diseases mentioned above. Because of their high content of unsaturated fatty acid especially linoleic acid (about 62.80 %), they can be used as an alternative for Sunflower (*Helianthus annuus*) oil as an ingredient in dietary products. The refined oil is used as dietary oil and to produce margarine.

Table 2 (a-j). The amounts of fatty acids of the seeds of *Papaver somniferum* L. in different provinces.

Table 2a. AFYON

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprillic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>AFYON</b>														
Başmakçı	49.93	0.83	-	0.71	1.39	1.84	-	-	8.49	68.42	-	12.92	1.01	2.60
Bayat	50.62	0.49	-	0.50	1.04	1.49	0.27	-	8.86	69.29	-	13.00	0.94	2.11
Bolvadin	30.56	1.47	0.60	1.65	3.53	4.97	0.47	-	8.31	62.49	-	11.06	0.93	2.08
Center	42.56	-	-	-	0.20	0.27	-	0.14	8.45	71.87	-	15.33	1.01	-
Çay	40.03	-	-	0.54	0.86	1.13	-	-	9.06	73.20	-	11.05	1.03	2.13
Çobanlar	40.81	-	-	-	0.93	1.25	-	-	8.72	66.61	-	12.78	1.03	4.01
Dazkırı	40.45	-	-	-	0.30	0.39	-	0.22	8.93	70.87	-	13.00	1.16	2.10
Dinar	50.40	-	-	-	0.60	1.15	-	-	9.41	69.32	-	12.62	1.09	1.62
Emirdağ	52.70	0.49	-	0.88	1.36	1.88	-	-	9.61	68.02	-	12.79	1.03	2.18
Evciler	37.27	-	0.12	0.22	0.56	0.78	-	-	8.99	71.61	-	13.54	0.96	2.32
Hocalar	44.78	-	-	-	-	0.82	-	-	11.42	67.20	-	11.77	1.14	2.40
İhsaniye	42.47	-	-	0.40	0.54	0.75	-	-	8.54	66.74	-	18.03	1.07	2.83
İscehisar	64.41	-	-	0.24	0.47	0.66	-	-	8.92	70.27	-	11.67	1.12	2.09
Sarımsaklı	43.34	-	-	1.13	2.82	4.73	0.74	-	10.39	56.38	-	23.81	-	-
Sincanlı	51.82	0.24	-	0.40	1.20	1.80	0.18	0.21	8.55	70.50	-	12.70	1.26	2.03
Sulandağı(1)	42.19	-	-	0.32	1.04	1.83	0.21	0.18	9.77	69.86	-	13.19	1.08	1.91
Sulandağı(2)	43.34	1.24	-	1.22	2.32	2.98	-	-	10.09	56.78	-	14.03	1.56	3.08
Şuhut	47.05	-	-	-	0.18	0.29	-	-	9.04	72.22	-	12.95	1.03	2.40

Table 2b. AMASYA

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprillic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>AMASYA</b>														
Center	44.71	-	-	-	0.50	0.70	-	-	10.15	63.62	-	13.20	1.07	-
Göynücek	42.65	1.20	-	2.72	0.76	1.86	5.52	-	16.66	32.63	-	19.89	1.61	3.38
Gümüş-hacıköy	47.88	-	-	-	-	-	9.78	-	23.00	35.48	-	25.06	-	-
Merzifon	45.36	1.87	-	2.35	-	2.53	3.23	-	16.40	43.89	-	18.99	-	3.94

Table 2c. BURDUR

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprillic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>BURDUR</b>														
Ağlasun	41.82	1.17	-	1.52	3.62	5.78	0.72	-	11.12	54.00	-	17.18	1.68	2.11
Bucak	51.76	3.53	1.67	3.35	6.40	8.45	-	-	7.02	55.32	-	11.00	-	3.26
Center	43.57	0.43	-	0.70	1.25	1.73	-	-	10.89	68.74	-	12.46	1.10	2.00
Çaldır	39.55	1.02	-	1.16	2.15	3.20	-	-	9.84	57.77	-	21.33	1.30	2.22
Çeltikçi	44.55	0.43	-	0.56	0.96	1.31	-	-	9.31	69.53	-	13.63	1.22	2.44
Gülhisar	50.67	0.96	-	0.94	1.91	2.57	-	-	9.29	67.41	-	12.86	1.05	2.31
Karamanlı	49.98	0.32	-	0.48	0.81	1.12	-	-	8.92	68.13	-	16.16	1.09	2.19
Kemer	43.53	0.42	-	0.58	1.01	1.31	-	-	9.43	68.58	-	13.81	1.01	2.31
Tefenni	41.45	0.60	-	0.77	1.39	1.86	-	-	9.65	69.45	-	13.20	1.07	2.05
Yeşilova	42.50	0.86	-	0.92	1.69	2.34	-	-	9.36	69.05	-	11.52	1.01	2.45

Table 2d. DENİZLİ

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprillic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>DENİZLİ</b>														
Acıpayam	40.86	-	-	0.79	1.74	2.96	-	-	9.56	56.14	-	27.40	-	1.81
Baklan	46.22	0.97	0.43	1.03	2.32	3.68	0.39	-	9.67	63.26	-	14.32	0.99	2.34
Bekilli	43.24	1.22	0.66	1.50	2.97	4.26	-	-	9.21	62.59	-	14.20	0.97	2.40
Buldan	34.42	-	-	0.60	1.81	3.15	0.37	0.24	11.34	65.50	-	13.66	1.47	1.88
Center	49.32	0.82	-	1.05	2.25	3.32	-	-	8.96	64.55	-	15.59	1.24	2.22
Çal	48.71	0.64	-	1.19	5.81	4.16	0.63	-	12.04	55.94	-	12.68	1.21	2.15
Çardak	51.84	0.55	-	0.86	1.98	3.30	0.40	-	10.92	67.88	-	11.41	0.79	1.91
Çivril	48.62	0.45	-	0.57	1.05	1.47	-	-	12.73	69.18	-	11.42	1.05	2.07
Güney	41.82	1.77	0.84	2.05	4.50	6.53	0.75	-	11.00	58.36	-	10.38	-	4.30
Honaz	47.19	-	-	0.20	0.45	0.58	0.12	0.16	10.17	69.31	1.95	13.37	1.14	2.31
Serinhisar	43.67	1.07	0.44	0.99	1.91	2.71	-	-	8.62	52.95	2.15	18.29	1.09	2.12

Table 2e. ISPARTA

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprillic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>ISPARTA</b>														
Center	50.17	-	-	-	-	0.78	-	-	10.72	69.86	-	14.07	0.86	2.14
Gelendost	51.84	-	-	-	0.64	1.11	-	-	11.12	70.65	-	11.78	1.06	2.04
Gönen	50.46	-	-	-	-	0.91	-	-	9.72	64.12	-	18.10	3.93	2.23
Keçiborlu	21.27	-	-	-	-	0.62	-	-	10.88	69.28	-	14.51	1.14	2.22
Ş. Kara-ağaç	49.76	-	-	-	0.23	0.36	-	-	9.85	71.71	-	10.77	1.04	2.07
Yalvaç	49.88	-	-	-	0.43	0.65	-	-	10.90	71.05	-	12.01	1.12	2.15

Table 2f. KONYA

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprilic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>KONYA</b>														
Adasz	55.48	-	-	-	-	1.11	-	-	9.77	69.34	-	12.21	-	2.44
Alunova	52.61	-	-	0.14	0.38	0.45	-	0.17	8.90	71.45	-	12.78	1.05	2.41
Derbent	47.59	-	-	0.25	0.36	0.55	-	-	9.91	72.76	-	12.59	1.09	2.17
Doğanhisar	50.91	-	-	-	0.27	0.68	-	-	10.00	73.53	-	13.08	-	2.44
Höyük	53.06	-	-	-	-	0.42	-	-	9.71	74.25	-	12.62	0.88	2.12
İlgin	47.24	-	-	-	-	0.88	-	-	9.90	68.45	-	17.10	1.08	2.60
Kadınhanı	48.20	-	-	-	0.27	0.62	0.17	-	9.04	71.19	-	14.77	1.08	2.15
Seiçukdu	51.49	-	-	-	0.36	0.72	-	-	9.75	74.91	-	11.76	1.10	2.00
Seydişehir	50.72	-	-	-	-	0.29	-	-	10.06	72.98	-	13.54	1.08	2.04
Tuzlukçu	59.07	-	-	-	1.16	1.99	1.13	-	11.60	63.22	-	15.66	1.47	2.81

Table 2g. KÜTAHYA

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprilic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>KÜTAHYA</b>														
Altıntaş	49.83	0.43	-	0.66	1.28	1.60	0.55	-	9.94	56.57	4.23	19.59	1.12	3.52
Aslanapa	47.21	0.40	-	0.46	0.99	1.41	-	-	9.18	63.25	-	20.09	1.07	2.44
Center	49.15	1.31	-	1.55	3.43	4.88	0.81	-	9.67	60.77	-	12.87	-	3.49
Domanıç	44.23	1.12	-	1.39	2.63	3.48	-	-	10.12	60.49	-	18.29	-	2.49
Dumlupınar	35.13	0.40	-	-	0.71	0.81	-	-	10.23	68.58	-	15.08	1.14	2.39
Emet	41.31	-	-	0.55	1.54	2.64	0.33	-	9.53	63.20	-	17.28	1.25	2.89
Gediz	45.90	-	-	-	2.10	1.74	-	-	14.00	57.36	-	18.05	1.47	2.82
Hisarcık	45.90	0.27	-	0.46	0.94	1.41	0.25	-	10.52	69.10	-	13.25	1.04	2.16
Pazarlar	40.18	0.64	-	0.77	1.57	1.99	-	-	10.86	62.45	-	15.94	0.99	2.47
Simav	53.17	0.67	0.33	0.77	2.07	6.76	1.26	-	10.23	59.11	-	13.57	0.92	2.41
Saphane	37.94	0.94	0.43	1.00	2.10	5.54	1.67	-	11.16	56.47	-	15.50	1.04	2.63
Tavşanlı	48.38	0.69	-	0.87	1.85	2.62	0.56	-	8.33	63.16	2.35	14.64	1.06	2.63

Table 2h. MANİSA

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprilic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>MANİSA</b>														
Kula	45.89	-	0.91	1.10	1.31	2.84	-	-	12.16	45.95	-	19.24	7.83	2.26
Selendi	38.21	-	-	0.36	0.43	0.63	-	-	10.26	68.69	-	11.78	1.30	1.78

Table 2i. TOKAT

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprilic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>TOKAT</b>														
Actova	49.52	-	-	-	-	-	-	-	11.37	71.45	-	12.21	0.85	2.04
Erbaa	46.18	-	-	-	-	0.95	-	-	11.55	71.74	-	12.38	-	1.79
Tuthal	40.66	-	-	-	0.24	0.38	-	0.18	9.90	68.56	-	14.92	1.03	2.06
Yurt	51.40	-	-	-	-	0.43	-	-	9.22	68.53	-	17.49	1.10	2.12

Table 2j. UŞAK

Provinces	Oil (%)	Caproic acid (%)	Heptanoic acid (%)	Caprilic acid (%)	Nonanoic acid (%)	Capric acid (%)	Undecanoic acid (%)	Palmitoleic acid (%)	Palmitic acid (%)	Linoleic acid (%)	Linolenic acid (%)	Oleic acid (%)	Elaidic acid (%)	Stearic acid (%)
<b>UŞAK</b>														
Banaz	45.69	0.92	0.48	1.22	2.69	3.98	-	-	9.52	66.90	-	11.01	1.16	2.14
Center	41.22	-	-	0.62	1.60	2.45	-	-	12.27	58.71	-	21.22	0.69	-
Eşme	31.65	1.38	-	2.49	4.72	7.23	-	-	10.90	57.51	-	12.71	-	3.06
Karahallı	34.21	0.71	0.44	0.94	1.89	2.23	-	-	10.59	65.29	-	14.94	1.08	1.88
Sivaslı	23.06	0.37	0.25	0.65	1.13	1.64	0.20	0.35	10.70	69.70	-	10.75	1.44	2.52
Ulubey	32.05	1.37	0.91	2.49	5.71	8.79	1.01	-	8.54	38.65	-	26.04	4.42	2.06

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**REFERENCES**

1. Davis PH. Flora of Turkey and the East Aegean Islands, Vol.1, Edinburgh University Press, Edinburgh, 219-236, 1965.
2. Evans WC. Trease and Evans' Pharmacognosy, Thirteenth Edition, Baillere Tindall, London, 582-591, 1989.
3. Baytop T. Therapy with Medicinal Plants in Turkey (Past and Present), Nobel Tıp Kitapevleri, Istanbul, 219-222, 1999.
4. Claus PE, Tyler VE, Brady LR. Pharmacognosy, 6th Ed., Lea and Febiger, Philadelphia, 248-250, 1974.
5. Baere T, Zhang X, Aubert B, Harry G, Lagrange C, Roppers J, Dufaux J, Lumbroso J, Rougier P, Ducreux M,

- Roche A. Quantification of Tumor Uptake of Iodized Oils and Emulsions of Iodized Oils: Experimental Study, *Radiology*, 201, 731-735, 1996.
6. Demirbaş A, Cengiz M, Yaylı N. Analysis of Fatty Acids from Turkish Plants, Modelling, *Meas. & Control*, C 45, 21-26, 1994.
  7. Yazıcıoğlu T, Karaali A. Türk Bitkisel Yağlarının Yağ asitleri Bileşimleri, TÜBİTAK Marmara Bilimsel Endüstriyel Araştırma Enstitüsü, Proje No.0501778203, Yayın No.70, Gebze-Kocaeli 1983.
  8. Marin P, Sajdl V, Kapor S, Tatic B. Fatty Acid Composition of Seeds of The Papaveraceae and Fumariaceae, *Phytochemistry*, 28, 133-137, 1989.
  9. Morrison WR, Smith LM. Preparation of Fatty Acid Methyl Esters and Dimethylacetals from Lipids with Boronfluoride-Methanol, *J. Lipid Res.*, 5, 600-608, 1964.
  10. Rynbergen M, Dibble A. Nutrition, 9th Ed., Houghton Mifflin Company, Boston, 33-35, 1979.
  11. Sencer E. Beslenme ve Diyet, Fatih Gençlik Vakfı Matbaa İşletmesi, İstanbul, 323-325, 1987.
  12. Aro A, Kardinal AF. Adipose Tissue Isometric Trans Fatty Acids and Risk of Myocardial Infarction in Nine Countries, *Lancet*, 345, 275-278, 1985.
  13. Holman RT, Susan B. Johnson BS. Linolenic Acid Deficiency in Man, *Nutr.Rev.*, 40, 144-147, 1982.
  14. Wright S, Burton JL. Oral Evening Primrose Seed Oil Improves Atopic Eczema, *The Lancet*, 20, 1120-1122, 1982.