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Variation in fatty acid composition of three turkish slit flower opium poppy (*Papaver somniferum* L.) lines

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Abstract

The opium poppy (*Papaver somniferum* L.) a member of *Papaveracae* family is a multipurpose medicinal or ornamental plant and a source for seed oil. Quality and nutritive value of poppy seeds is based on oil content and mainly polyunsaturated fatty acids. The United Nations recognize Turkey and India as traditional poppy producing countries. The aim of this study was to evaluate the seeds of three different Turkish slit flower opium poppy lines for their fatty acids percentage. The trial was carried out at the Experimental Fields of the Agronomy Department, Faculty of Agriculture of Ankara University, Turkey during 2010-2011. The material was collected from opium poppy collections in the department. All seeds were sown on 8 October 2010 and harvested during second week of July 2011. The oil of two samples of each line was extracted with hexane by foss soxtec 2055 apparatus. Fatty acids were analyzed by gas chromatography. Seed fatty acid percentage of three different slit flower lines was determined. The major fatty acid in seed oils was linoleic acid (72.17-74.66%); whereas, oleic and palmitic acid contents of seed oils ranged 13.21-15.55% and 8.25-8.85%, respectively. It is concluded that these poppy lines could be used as high linoleic acid, oleic acid and palmitic acid containing lines.

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Introduction

In recent years, the rise in the use of herbal medicines has given a fillip to the cultivation of medicinal plants which provide the active ingredient. The opium poppy (*Papaver somniferum* L.) (2*n* = 22) of the family Papaveraceae is a multipurpose crop which is used as a medicinal or ornamental plant, as well as a source for seed and oil.

This crop is placed among the important industrial oil plants in Turkey poppy seed oil usually range from 34 to 50% according to Turkish poppy seed varieties. Poppy seed oil has been used for a culinary purpose as salad oil, cooking oil. It is also used as desiccant in drying oil for in fine art, as in perfume, cosmetic, medicinal industries and as a vehicle for various parenteral formulations.

Fatty acid composition of opium poppy seed oil change as varieties change. In opium poppy seed oils from Turkey the main fatty acids are linoleic (56.4-69.2%), oleic (16.1-19.4%) and palmitic acids (10.6-16.3%) (Rahimi *et al.*, 2011), whereas, Şener *et al.* (1999) found that the oil content is in range of 45-50%. Arsalan *et al.* (2000) found that Turkish opium poppy seeds ranged 38.86 - 53.39%. The Normal and slit flowers of Turkish opium poppy lines are illustrated in Fig. 1. The aim of this study was to evaluate the seeds of three different Turkish slit flower opium poppy lines for their oil content and fatty acids percentage.

Materials and methods

Experimental study

The trial was carried out at the experimental fields of the Agronomy Department, Faculty of Agriculture of Ankara University, Turkey during 2010-2011. Three Turkish opium poppy lines were used in this study. The materials were token from opium poppy collections in the Agronomy Department Faculty of Agriculture, Ankara University. Some characteristics of varieties are summarized in Table 3.

Cultivation practices

All materials were sown in 4 rows as autumn planting in 12 October 2009. Sowing was performed as 30 x 10 cm of plant spacing. Each plot was 1.2 m × 4 m = 4.8 m^2. Normally fertilization and irrigation were applied to the experiment. During flowering, slit flower opium poppies were marked. Capsules of marked plants were harvested in the plots during second week of July 2010. The study evaluated based on the percentage of oil, fatty acids, non-saturated fatty acids and saturated fatty acids of three different seeds. Two types of mentioned seeds are shown in Fig. 2.

Oil and fatty acids analyze

Three samples of the seeds (~1 g) were ground and extracted with hexane by foss soxtec 2055 apparatus. Fatty acid methyl esters were prepared according the AOAC method (AOAC, 1990) and analyzed by Shimadzu (Kyoto, Japan) gas chromatography equipped with db 23 capillary column (30mx0.25mm film thickness 0.25µm) and fid (flame ionization detector). Helium at a flow rate of 1.0ml/min was used as a carrier gas. Injector and detector temperatures were 230 and 240°c, respectively. Column temperature was kept at 190°c for 30 min. A sample of 1 µl was injected by the autosampler with a split mode (split ratio of 1:80). The fatty acid identification was based on the comparison of their relative retention times with the corresponding fatty acid methyl ester standards. Individual reference methyl ester standards (myristic acid (C14:0), palmitic acid (C16:0), stearic acid (C18:0), oleic acid (C18:1), linoleic acid (C18:2), arachidic acid (C20:0), gadoleic acid (C20:1), behenic acid (C22:0) and lignoceric acid (C24:0) and as well as fatty acid methyl ester mix (37 components fame mix) were purchased from sigma chemical co. (Sigma-Aldrıch Gmbh, Sternheım, Germany).

Results and discussion

Oil concentration

The average of oil contents of seeds are presented in Table 4. The oil concentration was the highest (50.66%) in L_2 sample (yellow seed), whereas L_1 sample (blue seed) had the lowest oil yield (48.60%). Oil content in Ofis 96 was 43.73%, that is lower than

L1, L2 and L3 samples. Hlinkova *et al.* (2012) reported that oil content during 2007 ranged 43.3-49.9% and during 2009 ranged 40.8-50.1%. Rahimi *et al.* (2011) in a study under 18 Turkish cultivars showed that the oil content varied between 35.38%-47.95%. According to the results slit flower lines can compete with other lines and cultivars and registration of them as a cultivar will be useful economically.

Table 1. The long term and 2010-2011 outdoors climatic data of the experimental city.

Months	Rainfal (mm)		Temperature (C°)		Humidity	
	Long term	(2010-2011)	Long term	(2010-2011)	Long term	(2010-2011)
September	17.5	1.5	18.7	22.5	48.7	42.3
October	33.2	167.6	13.0	12.2	62.1	72.3
November	35.4	32.0	6.7	11.2	72.7	63.6
December	42.5	67.3	2.3	6.1		78.878.8
January	39.2	42.0	0.3	2.4		77.978.5
Fabruary	33.4	24.3	2.1	3.2		72.169.8
March	36.7	57.5	6.2	6.0		63.267.1
April	50.0	50.1	11.3	10.0		60.265.6
May	50.3	73.1	16.1	15.2		57.662.3
June	35.3	44.4	20.2	19.7		52.755.4
July	15.5	10.7	23.6	25.6		45.242.7
August	12.0	21.1	23.3	23.8		44.244.9

* The government meteorological association of Turkey.

Table 2. Soil analyses results of the experimental soil samples in the field before sowing.

Ph	7.9
$CaCO_3$ (kg/da)	8.35
Organic Material (%)	1.09
Organic Carbon (%)	0.62
P_2O_5 (kg/da)	6.42
K_2O (kg/da)	116
Salt (%)	0.043
Texture	Clay-Loam
EC (dS/m)	1.083
B.S.P	62

Fatty acids composition

Fatty acid composition of opium poppy seed oils is presented in Table 4. The linoleic, oleic and palmitic acids have been reported as major fatty acids in the opium poppy seed oil (Yazicioğlu and Karaali, 1983; Bajpai *et al.*, 1999; Bruneton, 1995). Opium poppy seed oils contained 89.06% (L_1)-89.51% (L_2) unsaturated fatty acids (average) made up mainly linoleic acid (C18:2). Saturated fatty acids (average) of the seed oils ranged 10.49% (L_2)-10.94% (L_1) made up mainly Palmitic (C16:0). In Ofis 96 unsaturated and Saturated fatty acids respectively were (average) 89.15% and 10.85%. Rahimi *et al.* (2012) found that unsaturated and saturated fatty acids in turkish lines ranged 88.80- 89.83% and 10.17- 11.20% respectively. Major fatty acid, linoleic acid (C18:2) is polyunsaturated fatty acid and is essential for human diet, ranged 72.17% (L_1)-74.66% (L_2) and 72.73% in Ofis 96. The linoleic acid content of selected slit flower in comparison with Ofis 96 were fine and acceptable. Linoleic acid is responsible for the biosynthesis of arachidonic acid and some prostaglandins. Oleic acid (C18:1) ranged 13.21% (L_2)-15.55% (L_1) and 15.52% in Ofis 96 is the second most

abundant unsaturated fatty acid and also major MUFA (mono-unsaturated fatty acid) in opium poppy seed oils. Therefore selected slit flowers in comparison with Ofis 96 have illustrated good result. Rahimi *et al.* (2011) reported that linoleic and oleic acid content of opium poppy oil ranged 68.76-74.22% and 13.30-17.80% respectively depending on cultivars. Azcan *et al.* (2004) found concentrations of linoleic and oleic acids as 56.4 - 69.2% and 16.1 - 19.4% respectively depending on the color of the seeds. Şener *et al.* (1999) reported that linoleic and oleic acid content of opium poppy seeds from different locations changed between 32.63-74.31% and 10.38-27.04%, respectively. Singh *et al.* (1990) found that Linoleic and oleic acid contents of Indian opium poppy seed oils ranged 41.0-68.0% and 13.22-36.79% respectively (Yazicioğlu and Karaali, 1983). Marin *et al.* (1989) reported that linoleic and oleic acid contents were about 79.3% and 9.0% respectively. Linoleic acid contents in most of samples were higher compared to data of Azcan *et al.* (2004) and Singh *et al.* (1990), lower than Marin *et al.* (1989) and similar to Rahimi *et al.* (2011). Oleic acid contents were similar to the data of Rahimi *et al.* (2011) and Azcan *et al.* (2004) and higher than results of Marin *et al.* (1989). Most of the results with respect to linoleic and oleic acid content are consistent with Şener *et al.* (1999). Linolenic acid (C18:3) is the third fatty acid and the second PUFA in opium poppy seed oils and its content ranged 1.07% (L_1)- 1.32% (L_2) and 0.68% in Ofis 96. High linolenic content is undesirable for vegetable oils as it is prone to autoxidation causıng off-flavor compounds in oils (Yazicioğlu and Karaali, 1983). Linolenic acid content appears to be similar to the material analyzed by Rahimi *et al.* (2011), Rahimi *et al.* (2012), Azcan *et al.* (2004) and Singh *et al.* (1990). However, linolenic acid was not identified by Marin *et al.* in their samples. Cowan *et al.* (1970) found that relation between flavor perception and oils relates to the linolenic acid contents in oil. A taste panel showed best scores for cottonseed oil (0%) followed by copper-reduced (0%) and nickel-reduced soybean oils (3%). The amounts of the other unsaturated fatty acids were below 0.29%. palmitoleic (C16:1, 0.23-0.27%), heptadecenoic (C17:1, 0.02-0.03%) and gadoleic acid (C20:1, 0.01-0.03%) were MUFA found in trace amounts in all oil samples. Palmitoleic, heptadecanoic and gadoleic acids were identified by Rahimi *et al.* (2011) and Rahimi *et al.* (2012) and not by Azcan *et al.* (2004), Singh *et al.* (1990), Şener *et al.* (1999) and Marin *et al.* (1989).

Table 3. Some identification characteristics of opium poppy seeds in this trial.

Line No.	Seed color	Flower color
L_1	blue	Violet
L_2	Yellow	White
L_3	blue	Violet
Ofis 96	Yellow	White

Palmitic (C16:0) and stearic acid (C18:0) were found as major saturated fatty acids in all seed oils. The percentage of palmitic acid in seed oils ranged 8.25% (L_2)-8.85% (L_1) and 8.39 %in ofis 96. Stearic acid varied between 1.89% ($L_{1,3}$)-2.03% (L_2) 2.27% in Ofis 96. Saturated fatty acid in Ofis 96, just in heptadecanoic acid are higher than selected lines. Rahimi *et al.* (2011) reported that palmitic and stearic acids depending on registered cultivars changed between 7.96% to 10.19% and 1.84% to 2.40% respectively. Palmitic acid and stearic acids were found in Indian opium poppy seed oils as 8.90-21.48% and 1.40-10.80%, respectively (Singh *et al.*,1990) Azcan *et al.* (2004) reported that palmitic and stearic acids changed depending on the color of seeds and their percentage ranged 10.0-13.0% and 2.5-3.2%, respectively. Şener *et al.* (1999) determined palmitic and stearic acid contents as 8.33-23.00% and 0-4.30%, respectively.

Palmitic and stearic acids were found as 9.6% and 1.9% by Marin *et al.* (1989). Our results with respect

to palmitic and stearic acid concentrations are consistent with Rahimi *et al.* (2011), Azcan *et al.* (2004), Singh *et al.* (1990) and Marin *et al.* (1989). The other three saturated fatty acid in opium poppy seed oils, myristic (C14:0), heptadecanoic (C17:0) and arachidic acid (C20:0) were also present in small concentrations usually accounting for less than 0.13% of the oil composition.

Table 4. Oil content and fatty acid composition (%) of opium poppy seeds in different lines.

Line No.	Oil %	C14:0	C16:0	C17:0	C18:0	C20:0	S.*	C16:1	C17:1	C18:1	C18:2	C18:3	C20:1	U.S.*
L_1	48.60	0.05	8.85	0.05	1.89	0.09	10.94	0.23	0.03	15.55	72.17	1.07	0.01	89.06
L_2	50.66	0.05	8.25	0.05	2.03	0.12	10.49	0.27	0.02	13.21	74.66	1.32	0.03	89.51
L_3	49.00	0.04	8.65	0.05	1.89	0.07	10.71	0.23	0.03	14.06	73.87	1.09	0.02	89.29
Ofis 96	43.73	0.05	8.39	0.06	2.27	0.09	10.85	0.13	0.02	15.52	72.73	0.68	0.06	89.15

*S.: saturated fatty acids and U.S. unsaturated fatty acids.

Fig. 1. Normal (right) and slit (left) flowers of Turkish opium poppy lines.

Fig. 2. Yellow (right) and blue (left) seeds of Turkish opium poppy lines.

Conclusion

In conclusion, three Turkish slit flower opium poppy lines are major source of raw materials such as oil with potential application as non-traceuticals and functional foods. According to analyzed results, three Turkish slit flower opium poppy lines oil content and the percent of fatty acid were displayed the same result as Ofis 96. The major fatty acids in the seed oil were linoleic, oleic and palmitic acids. The seed oils had a balanced fatty acid distribution having a high content of unsaturated fatty acids. Linoleic and oleic acids are two important unsaturated fatty acids in human diet. Increase in their concentration relates to the quality of related oil. With a balanced fatty acid composition, the seeds could be used in some foods to improve their nutritional value. Legal opium poppy production is allowed under the rules of the United Nations and Turkey is one of legal producer. Protection of traditional opium poppy producing position for Turkey is very important. Industrial evaluation of opium poppy seed and producing oil can protect this position of Turkey.

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