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Effect of Different Maturity Stages in Safflower (*Carthamus tinctorius* L.) on Oil Content and Fatty Acid Composition

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Abstract: This study was conducted to investigate changes in the hull ratio, 1000-seed weight, oil content and fatty acid composition of safflower seeds obtained from four different maturity stages (10 days intervals from initial seed formation to full maturity). In 2010, field trial was performed at the experimental fields of Field Crops Central Research Institute in Ankara-Haymana. According to the results, the evaluated parameters varied with cultivars and different maturity stages greatly. In accordance with progressive maturity stages for all cultivars, while a decrease in the hull ratio was determined, the oil content was found to be an increase. Fatty acids, linoleic and oleic acid were main oil components for all cultivars, and fatty acid composition varied among cultivars and in different maturity stages.

Keywords: Safflower, *Carthamus tinctorius* L., Hull ratio, Oil content, fatty acid composition and maturity stage

Farklı Olgunlaşma Dönemlerinin Aspir (*Carthamus tinctorius* l.) Bitkisinin Yağ Oranı ve Bileşenlerine Etkileri

Özet: Bu çalışma dört farklı gelişme döneminde (tohum oluşum başlangıcından tam olgunlaşmaya kadar 10'ar gün arayla) hasad edilen aspir tohumlarının kabuk oranı, 1000 tohum ağırlığı, yağ oranı ve yağ asidi bileşenlerini belirlemek amacıyla yapılmıştır. Tarla denemesi, Tarla Bitkileri Merkez Araştırma Enstitüsü'nün Ankara-Haymana'daki deneme tarlasında 2010 yılında yürütülmüştür. Elde edilen sonuçlara göre değerlendirilen parametreler çeşitlere ve farklı olgunlaşma dönemlerine bağlı olarak büyük oranda değişiklik göstermiştir. Çeşitlerin tümünde ilerleyen olgunlaşma dönemlerine bağlı olarak kabuk oranlarında azalma belirlenirken yağ oranlarında ise bir artışın olduğu tespit edilmiştir. Linoleik ve oleik asit tüm çeşitler için yağ asitleri kompozisyonunun ana komponentleri olarak belirlenmiştir. Yağ asitleri kompozisyonu çeşitlere ve olgunlaşma dönemlerine bağlı olarak değişiklik göstermiştir.

Anahtar kelimeler: Aspir, *Carthamus tinctorius* L., Kabuk oranı, Yağ oranı, Yağ asiti bileşeni ve Olgunlaşma dönemi.

Introduction

Safflower (*Carthamus tinctorius* L.), as an oil plant, has been known since ancient times. It is cultivated in U.S.A., Israel, Morocco, Spain, Italy, France, Pakistan, India and Australia. Safflower has been cultivated mainly for the edible oil produced from its seeds, medicine and dye produced from its flower petals. It is mentioned that safflower oil has wide uses in the pharmaceutical industry owing to its purgative and anti-rheumatismal

effects (Geçgel et al., 2005). It does not result in an increase in the cholesterol level in the blood. Pigments produced from flower petals are particularly important due to the fact that they leave no toxic residues in the coloured products such as foods, textiles (Mateaş and Tabara, 2010). The residual meal after oil extraction may be used to feed animals due to its high crude protein and fiber content (Geçgel et al., 2005).

Safflower belongs to family *Asteracea,* and is an annual oilseed plant. There are spiny and spineless varieties of safflower. It has a composite-type of inflorescence with each plant producing several flowering heads known as capitula. Every capitulum has 20-200 flowers. Each flower has an inferior ovary developing into a single seed achene (Vrijendra et al., 2005). The flower of safflower has the corolla tube 1.8-3.0 cm long and five petal lopes. The plant possesses five anter fusing to make a tube of 5.0 to 7.0 mm length. There is the style terminated by a stigma in the anter tube. These styles stem beyond the top of the anter about 5-6 mm. Every flower develops a single seed. (Sign et al., 2005; Coşge et al., 2007). The seeds are white or cream in colour and their typical composition is 55-65 % kernel, 33-45 % hull, 27-32 % oil, 5-8 % moisture, 14-15 % protein, 2-7 % ash and 32-40 crude fiber (Geçgel et al., 2005).

Although Turkey is a self-sufficient country in many crops, insufficiency of production in vegetable oil has not yet been solved (Bayraktar et al., 2005). According to 2008 data, so as to meet the excessive demands for vegetable oil, Turkey imports about 1.702 billion dollar vegetable oil annually (Anonymous, 2009). Cotton, sunflower, olive oil, sesame, opium poppy, groundnut, soybean, safflower, maize, and rapeseed are sources of oil in Turkey (Arıoğlu et al., 2010). Sunflower is the most important oil crop in our country and meets 65 % of total vegetable oil production. To recover the deficiency of vegetable oil production it is necessary to enhance amount and diversity oil crops. Generally, growing of oil crops in Turkey have been done in coastal areas and in temperature zones (Bayraktar et al., 2005).

Although safflower has a great potential in Turkey and it is also a native plant possessing wild relatives in many parts of our country, it is not a major oilseed crop (Esendal., 2005). But safflower is an alternative oil crop cultivated on dry lands of Central Anatolia and surrounding regions having insufficient rainfall (Bayraktar et al., 2005).

Safflower is a minor, underutilized oilseed crop. But oil quality of safflower is very high due to fatty acid composition. Its oil constitutes an important source of polyunsaturated fatty acid for many people in some parts of the world (Shivani et al., 2010). The fatty acid composition of vegetable oil is an important factor which affects its commercial uses. (Velasco and Fernandez-Martinez, 2001). Safflower is one of the best examples of variability known for the fatty acid composition of the seed oil (Velasco and Fernandez-Martinez, 1999). Generally, safflower oil possesses approximately 6-8 % palmitic acid, 2-3 % stearic acid, 16-20 % oleic acid, and 71-75 % linoleic acid. Variants with increased stearic acid content (4 % to 11 % of the total fatty acid), intermediate oleic acid content (41 to 53 %), high oleic acid content 75 to 80 %), very high oleic acid content (>85 %), and very high linoleic acid content (87 to 89 %) have been determined (Velasco and Fernandez-Martinez, 2001). In addition, very low levels of miristic (0.24 %) and behenic (0.43 %) acids were recorded in its oil (Baydar, 2000). Oil content and fatty acid components of oil crops are determined by a number of factors such as genotype, morphology, physiology of the plant, ecology cultivated and cultivation techniques (Karaca and Aytaç, 2007).

The aim of this research was to determine changes in the hull ratio, 1000-seed weight, oil content and fatty acid composition of safflower seeds obtained from different maturity stages (10 days intervals starting from 20^{th} to 50^{th} days after 50 % flowering) in Haymana District of Ankara Province.

Materials and Method

Climate and Soil Characteristics of Research Field

In 2010, field trial was performed at the experimental fields of Field Crops Central Research Institute in Haymana District of Ankara province (32^0 51 E; 39^0 57 N; 860 m above sea level). Soil characteristics of trial field were as follows: clay and loam, pH 7.74, lime 26.1 %, salt 0.051 %, organic matter 1.63 %, phosphorus 25.61 kg/da and potassium 210.63 kg/da Table 1. Haymana District of Ankara Province where the trial was performed has a typical steppe climate with high temperature differences between day and night. Summers are dry and winters are relatively rainy. Temperature, rainfall, relative humidity and total and mean values of these meteorological data were presented in Table 2.

Plant Material

Dinçer 5-18-1 (spineless), Remzibey-05(spiny), and Shifa (spineless) cultivars were used in trial as plant materials. Dinçer 5-18-1 and Remzibey-05 cultivars were developed at Anatolia Agricultural Research Institute in Turkey. Shifa cultivar was obtained from Tajikistan.

Method

Field experiment was laid out in a split plots in randomized complete block design with three replications. The cultivars (Dinçer 5-18-1, Remzibey-05 and Shifa) and four different maturity stages (10 days intervals from initial seed formation to full maturity and the first plots was harvested on 9 August 2010) were randomized into main and sub plots, respectively. Seeds were sown with 30 cm row spacing on plots of 6 m^2 harvest area (1.20 m width X 5 m length) on 19 March 2010. After intra-row spacing was stabilized at 10 cm by thinning (Kızıl et al., 1999). Weed control was made by means of manual weeding in rows. All treatments were fertilized with 10 kg nitrogen and 6 kg phosphorus per decare. Ten plants per plot were selected as randomly. The plants were harvested 10 days intervals from initial seed formation to full maturity. Harvests were made by hand. Seeds obtained from these plants were used for analysis.

Tablo1. Araştırma alanının toprak özellikleri
Table 1. Soil Characteristics of Research Area

Bünye *Structure*	Kireç (%) *Lime* (%)	Toplam Tuz (%) *Total Salt* (%)	Faydalanılabilir Fosfor *Available Phosphorus* (P_2O_5) (kg/da)	Faydalanılabilir Potasyum Availa*b*le *Potassium* (K_2O) (kg/da)	pH	Organik Madde *Organic Matter* (%)
Killi-tınlı *Clay-Loam*	26,1	0,051	25,61	210,63	7,74	1,63

Oil Extraction and GC-MS Analysis

The seeds were properly ground and the oil extracted with n-hexane in a Soxhlet extractor for 4 h. Recovered crude oils were taken to dry out on a rotator evaporator at 35 ^{0}C. Fatty acids were esterified as methyl esters and analysed by Agilent 6890N Network with equipment with DB-23 capillary column (JW Scientific 122-2362 DB-23 ;60.0 m x 250 µm x 0.25 µm) GC and FID detector. Helium was used as carrier gas at a flow rate of 1 mL/min. Injector and detector temperature were 260 ^{0}C and 240 ^{0}C, respectively. Column temperature was kept at 220 ^{0}C for 69 min. Samples of 0.5 uL was injected by hand and in the split mode (20:1). FAMEs were identified by comparison of their retention times with those of reference standards. The content of fatty acids was calculated from corresponding integration data.

Tablo 2. 2010 yılına ait minimum, maksimum ve ortalama sıcaklık ve yağış değerleri
Table2. Minimum, maximum and mean monthly temperature and total rainfall in 2010

2010 yılı iklim değerleri *Climatic data in* 2010	Mart *March*	Nisan *April*	Mayıs *May*	Haziran *June*	Temmuz *July*	Ağustos *August*	Eylül *September*
Min. Sıcaklık ºC *Min. temperature* ºC	-7.4	-1.7	1.6	9.2	12.6	13.4	7.7
Maks. Sıcaklık ºC *Max. temperature* ºC	21.1	21.8	28.9	30.6	35.2	38.6	31.4
Ortalama sıcaklık ºC *Mean temperature* ºC	6.8	9.4	14.6	19.1	20.6	25.5	17.09
Yağış miktarı (mm) *Rainfall* (*mm*)	41.0	13.8	21.7	75.8	19.8	0	0

Kaynak: Meteoroloji Genel Müdürlüğü
Reference: General Directorate of State Meteorology Affairs.

Statistical Analysis

With split plots in randomized complete block design, analytical data collected with three replications of each treatment were subjected to analysis of variants using MSTAT-C statistical program, and difference between means were compared via the LSD (Least Significant Difference) test using the same program (Düzgüneş et al., 1987)

Result and Discussion

1000-Seed Weight (g)

Analysis of variance was performed to test the significance of difference among the cultivars and different maturity stages and the cultivars X different maturity stages interactions for the 1000 seeds weight (g). Analysis of variance for 1000-seed weight is shown in Table 3. Analysis of variance revealed that the variation among the cultivars, different maturity stages and the interaction of the cultivars X different maturity stages was found to be significant ($P < 0.001$) for the 1000 seeds weight (g).

1000-seed weight was influenced by the different cultivars (Table 4). The Shifa produced the highest 1000-seed weight of 49.92 g against the minimum (38.99 g) recorded in Remzibey-05. Dinçer 5-18-1 cultivar also gave 1000-seed weight (41.40 g). This increase could be due to difference of cultivars.

The data on 1000-seed weight showed that the different maturity stages had a significant effect on this parameter (Table 4). The delay of the harvesting increased 1000 seed weight: 35.87 g at 1^{th} maturity stage, 42.57 g at 2^{th} maturity stage, 47.10 gr at 3^{th} maturity stage and 48.20 gr at 4^{th} maturity stage. Data of 1000 seed weight indicated that the maximum 1000 seed weight of 48.20 g was obtained by 4^{th} maturity stage, while 1^{th} maturity stage produced the minimum 1000 seed weight of 35.87 g. 1000-seed weight increased gradually up to the last maturity stage. The gradual increases in 1000-seed weight may be due to increasing seed growth. The number of filled seeds increased linearly with each increase in maturity stages. The increased number of filled seeds per capitulum in 3^{th} maturity stage and 4^{th} maturity stage may be attributed to this situation. Because these maturity stages having longer period than other maturity stages possessed the better plant growth and development and helped in uptake of more nutrients.

Significant differences ($P < 0.01$) for the 1000-seed weight (g) were observed between interactions of the cultivars and different maturity stages (Table 4). 1000-seed weight ranged from 29.84 gr (Remzibey-05 x 1^{th} maturity stage interaction) to 53.56 gr (Shifa x 4^{th} maturity stage interaction). These changes could be owing to difference of cultivars and increasing seed growth. These findings are in agreement with those reported by Çamaş et al. (2007), Yılmazlar (2008), Polat (2007) and Sağıoğlu et al. (2005).

Tablo 3: Bin tohum ağırlığı (g), yağ (%) ve kabuk oranına (%) ait varyans analizi
Table 3. Analysis of variance for the 1000 seeds weight (g), oil content (%) and hull ratio (%)

Varyans Kaynakları *Sources*	Serbestlik Derecesi *Degrees of Freedom*	Kareler ortalaması *Mean square*		
		Bin Tohum ağırlığı (g) *1000 seeds weight (g)*	Kabuk oranı (%) *Hull ratio (%)*	Yağ oranı (%) *Oil content (%)*
Tekerrür *Replication*	2	7.614	1.029	1.593
Çeşit (A) *Cultivar (A)*	2	396.201**	139.417**	45.606**
Hata 1 *Error1*	4	1.428	1.682	1.013
Olgunlaşma Dönemi (B) *Maturity Stage (B)*	3	282.370**	219.121**	188.469**
AxB	6	12.261**	22.028**	49.299**
Hata 2 *Error 2*	18	3.893	0.874	1.789
Toplam *Total*	35			

** %1 düzeyinde önemli, * %5 düzeyinde önemli, ** Significant at P < 0.01, * P < 0.05, respective

Tablo 4. Aspir çeşitlerinin farklı gelişim dönemlerindeki 1000 tohum ağırlığındaki değişimler
Table 4. Changes in 1000 seeds weight (g) in different maturity stages of safflower cultivars.

Olgunluk dönemleri *Maturity stages*	Çeşitler *Cultivars*			
	Dinçer 5-18-1	Remzibey-05	Shifa	Ort. *Mean*
İlk olgunluk dönemi* *First maturity stage**	33.41d	29.84e	44.37c	35.87c
Ikinci olgunluk dönemi** *Second maturity stage***	42.78c	36.39d	48.53b	42.57b
Üçüncü olgunluk dönemi*** *Third maturity stage****	43.53c	44.56c	53.23a	47.10a
Dördüncü olgunluk dönemi**** *Forth maturity stage*****	45.87bc	45.16bc	53.56a	48.20a
VK % *CV %*	4.54			

* The first plots were harvested on 9 August 2010. The other plots were harvested 10 days intervals from the first harvest to full maturity

Hull ratio (%)

Analysis of variance was performed to test the significance of difference among the cultivars and different maturity stages and between interactions of the cultivars and different maturity stages for the hull ratio (%). Analysis of variance for the hull ratio (%) is indicated in Table 3. Analysis of variance revealed that the variation among the cultivars, different maturity stages and the cultivars X different maturity stages interaction was significant (P < 0.01) for the hull ratio (%).

The hull ratio (%) was influenced by the different cultivars (Table 5). The Dinçer 5-18-1 cultivar gave the highest hull ratio of 53.19 % against the minimum (46.41%) recorded in Shifa. Remzibey-05 cultivar also gave hull ratio (50.41%). This change could be due to the difference of cultivars.

The findings for hull ratio (%) indicated that the different maturity stages had a significant effect on this parameter (Table 5).

The delay of the harvesting reduced the hull ratio: 57.36 % at 1th maturity stage, 47.51 g at 2th maturity stage, 48.22 % at 3th maturity stage and 46.91 % at 4th maturity stage. Data of hull ratio (%) indicated that the maximum hull ratio (%) of 57.36 g was obtained by 1th maturity stage, while 4th maturity stage produced the minimum hull ratio of 46.91 %. The hull ratio (%) decreased gradually up to the last maturity stage. The gradual reduces in the hull ratio (%) may be due to increasing seed growth. The increased number of filled seeds per capitulum under 3th maturity stage and 4th maturity stage may be attributed to this.

Significant differences ($P < 0.01$) for hull ratio (%) were observed between interactions of the cultivars and different maturity stages (Table 5). The hull ratio (%) ranged from 44.37 % (Shifa x 2th maturity stage interaction) to 61.24 % (Remzibey-05 X 1th maturity stage interaction). These changes could be owing to difference of cultivars and increasing seed development.

These findings are in close agreement with those reported by Rahamatalla et al. (2001), Geçgel et al. (2005), Yılmazlar (2008) and Sağıoğlu et al. (2005).

Tablo 5. Aspir çeşitlerinin farklı gelişim dönemlerinde kabuk oranındaki değişimler
Table 5. Changes in hull ratio (%) in different maturity stages of safflower cultivars.

Olgunluk dönemleri *Maturity stages*	Çeşitler *Cultivars*			
	Dinçer 5-18-1	Remzibey-05	Shifa	Ort. *Mean*
İlk olgunluk dönemi *First maturity stage*	61.07a	61.24a	49.77cd	57.36a
Ikinci olgunluk dönemi *Second maturity stage*	50.60c	47.55ef	44.37h	47.51bc
Üçüncü olgunluk dönemi *Third maturity stage*	52.34b	46.26fg	46.08fg	48.22b
Dördüncü olgunluk dönemi *Forth maturity stage*	48.75de	46.26fg	45.42gh	46.91c
VK % *CV %*	1.604			

Values within a column followed by the different letters are significantly different at the 1 % level (Duncan's multiple range test)

Oil content (%)

Analysis of variance was performed to test the significance of difference among the cultivars and different maturity stages and between interactions of the cultivars and different maturity stages for the oil content (%). Analysis of variance for the oil content (%) is indicated in Table 3. Analysis of variance revealed that the variation among the cultivars, different maturity stages and the cultivars X different maturity stages interaction was significant ($P < 0.01$) for the oil content (%).

The oil content (%) was influenced by the different cultivars (Table 6). The Dinçer 5-18-1 cultivar gave the highest the oil content of 24.22 % against the minimum (20.58 %) recorded in Remzibey-05. Shifa cultivar also gave the oil content (23.63%). This change could be due to difference of cultivars.

The findings the oil content (%) indicated that the different maturity stages had a significant effect on this parameter (Table 6). The delay of the harvesting increased the oil content (%): 16.27 % at 1th maturity stage, 23.04 % at 2th maturity stage, 25.74 % at 3th maturity stage and 26.18 % at 4th maturity stage. Data of the oil content (%) indicated that the maximum the oil content of 26.18 % was obtained by 4th maturity stage, while 1th maturity stage produced the minimum oil content of 16.27 %. The oil content (%) increased gradually up to the last maturity stage.

Significant differences ($P < 0.01$) for the oil content were observed between interactions of the cultivars and different maturity stages (Table 6). The oil content (%) ranged from 12.17 % (Remzibey-05 x 1th maturity stage interaction) to 28.30 % (Dinçer 5-18-1 X 2th maturity stage interaction). These changes could be owing to difference of cultivars and increasing seed development.

Tablo 6. Aspir çeşitlerinin farklı gelişim dönemlerinde yağ oranındaki değişimler
Table 6. Changes in Oil content (%) in different maturity stage of safflower cultivars.

Olgunluk dönemleri *Maturity stages*	Çeşitler *Cultivars*			
	Dinçer 5-18-1	Remzibey-05	Shifa	Ort. *Mean*
İlk olgunluk dönemi *First maturity stage*	15.93f	12.17g	20.70e	16.27c
Ikinci olgunluk dönemi *Second maturity stage*	28.30a	15.83f	25.00cd	23.04b
Üçüncü olgunluk dönemi *Third maturity stage*	26.17abc	27.40ab	23.67d	25.74a
Dördüncü olgunluk dönemi *Forth maturity stage*	26.47abc	26.93abc	25.13bcd	26.18a
VK % *CV %*	5.86			

Values within a column followed by the different letters are significantly different at the 1 % level (Duncan's multiple range test)

The findings are in close agreement with those reported by Şakir and Başalma (2005), Geçgel et al. (2005), Aslan and Küçük (2005), Yılmazlar (2008) and Sağıroğlu et al. (2005).

Fatty acid composition

Changes in fatty acids are of special importance to the quality of the oil. In the present study, fatty acid accumulation patterns resulting from seed development duration were analyzed. The findings showed that the composition of fatty acids changed significantly during seed development (Table 7).

Palmitic acid, stearic acid, oleic acid and linoleic acid comprised over 99% of total lipids on the average, and of these oleic and linoleic acids comprised over 90% of total fatty acid. Changes in the contents of oleic and linoleic acids were clearer than those in the palmitic acid and stearic acid during seed development. The accumulation patterns of palmitic and stearic acids were similar, with slight fluctuation as the seed development. Stearic acid content for Remzibey-05, Dinçer 5-18-1 and Shifa cultivars reduced with seed development, reaching minimum values of 2.38% (at 3th maturity stage), 2.31 % (at 4th maturity stage) and 2.24 % (at 1th maturity stage), respectively. Palmitic acid content for Remzibey-05, Dinçer 5-18-1 and Shifa cultivars reduced with seed development, reaching minimum values of 5.81% (at 3th maturity stage), 7.04 % (at 3th maturity stage) and 6.30 % (at 2th maturity stage), respectively.

A decrease in the synthesis of oleic acid and increase in the synthesis of linoleic acid were observed during the development of safflower seeds, with slight fluctuation. When the seeds developed from 1th maturity stage to 4th maturity stage for Remzibey-05, Dinçer 5-18-1 and Shifa cultivars, oleic acid content decreased from 28.5 %, 14.54% and 11.58 % to 26.47%, 12.31 % and 11.22%, respectively. In addition, when the seeds developed from 1th maturity stage to 4th maturity stage for Remzibey-05, Dinçer 5-18-1 and Shifa cultivars, linoleic acid content increased from 59.64 %, 73.65% and 78.14% to 63.47%, 76.98% and 78.76%, respectively. The findings are in agreement with those reported

by Coşge, et al. (2007) and Sağıroğlu et al. (2005).

Conclusion

Safflower is a minor, underutilized oilseed crop. But oil quality of safflower is very high due to fatty acid composition. Its oil constitutes an important source of polyunsaturated fatty acid many people in the parties of the world.

Fatty acid components of oil crops are determined by a number of factors such as genotype, morphology, physiology of the plant, ecology cultivated and cultivation techniques. The fatty acid composition of vegetable oil is an important factor which affects its commercial uses. The findings shown revealed that mean data for palmitic, stearic, oleic and linoleic acids in safflower cultivars differed widely. Linoleic acid predominated in every lipid class during the whole period of seed development of safflower cultivars.

Tablo 7. Aspir çeşitlerinin faklı olgunluk dönemlerine ait yağ asiti kompozisyonu
Table 7. Fatty acid composition of safflower cultivars and different maturity stages

	Çeşitler Cultivars											
	Remzibey-05 Olgunluk Dönemi Maturity Stage				Dinçer 5-18-1 Olgunluk Dönemi Maturity Stage				Shifa Olgunluk Dönemi Maturity Stage			
Yağ Asidi Kompozisyonu Fatty acid composition	1	2	3	**4**	1	2	3	**4**	1	2	3	**4**
Nervonik asit Nervonic acid	0,12	0,14	0,18	**0,15**	0,12	0,12	0,08	**0,17**	0,19	0,17	0,12	**0,1**
Lignoserik asit Lignoseric acid	0,16	0,11	0,13	**0,13**	0,16	0,11	0,1	**0,12**	0,12	0,09	0,08	**0,08**
Erusik asit Erusic acid	-	-	-	**-**	-	-	-	**-**	-	-	-	**-**
Behenik asit Behenic acid	0,37	0,31	0,31	**0,28**	0,31	0,23	0,2	**0,21**	0,26	0,2	0,19	**0,18**
Ekosenoik asit Ecosenoic acid	0,18	0,18	0,21	**0,19**	0,14	0,14	0,14	**0,15**	0,16	0,17	0,17	**0,16**
Araşidik asit Araşidic acid	0,54	0,45	0,43	**0,38**	0,45	0,34	0,31	**0,33**	0,37	0,3	0,3	**0,29**
Linolenik asit Linolenic acid	0,17	0,09	0,06	**0,07**	0,12	0,09	0,08	**0,09**	0,12	0,12	0,09	**0,09**
Linoleik asit Linoleic acid	**59,64**	**62,47**	**50,82**	**63,47**	**73,65**	**77,09**	**77,3**	**76,98**	**78,14**	**79,46**	**78,3**	**78,76**
Oleik asit Oleic acid	**28,5**	**26,89**	**39,43**	**26,47**	**14,54**	**12,12**	**11,67**	**12,31**	**11,58**	**10,62**	**11,32**	**11,22**
Stearik asit Stearic acid	2,84	2,62	2,38	**2,46**	2,57	2,41	2,39	**2,31**	2,24	2,33	2,4	**2,34**
Heptadesenoik asit Heptadesenoic acid	-	-	0,02	**-**	-	0,02	-	**0,03**	0,02	0,02	0,02	**-**
Heptadekanoik asit Heptadekanoic acid	0,9	0,03	0,04	**0,07**	0,06	0,02	0,09	**0,03**	0,03	0,04	0,05	**0,1**
Palmitoleik asit Palmitoleic acid	0,11	0,09	0,08	**0,08**	0,11	0,1	0,1	**0,1**	0,08	0,07	0,1	**0,07**
Palmitik asit Palmitic acid	7,17	6,51	5,81	**6,13**	7,63	7,08	7,39	**7,04**	6,57	6,3	6,73	**6,5**
Miristik asit Miristic acid	0,12	0,12	0,1	**0,11**	0,15	0,14	0,15	**0,15**	0,13	0,12	0,13	**0,12**

As a result, we could recommend Remzibey-05 cultivar and the third maturity stage (on 30 August) for both high oil content and vegetable oil with high oleic acid in Haymana District of Ankara Province.

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