OIL YIELDS, FATTY ACID COMPOSITIONS AND TOCOPHEROL CONTENTS OF GRAPE SEED OILS FROM TURKEY

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ABSTRACT

In the present study, the oil contents, fatty acid composition and tocopherol contents of grape seed and corresponding oils were analyzed by using Gas Chromatograph and High Performance Liquid Chomotography. The results showed that the oil concentration of seeds ranged from 7.9 to 20.1 % Grape seed oils were rich in oleic and linoleic acids, ranging from 12.9 to 27.1 % and 58.3 to 74.8 %, respectively. In addition, A few types of tocopherols were found in grape seed oils in various amount: α-tocopherol, α-tocotrienol, γ-tocopherol, β-tocotrienol and α-tocotrienol. As a result, present study shows that oil, fatty acid composition and tocopherol contents differ significantly among the cultivars.

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Keywords*:* grape seed oil, fatty acid composition, gas chromatograph, tocopherol.

1. Introduction

The potential and current sources of oils, not only restricted to seeds, but also are included in food industry by-products. Grape seeds are waste products of the wine and grape juice industry [1]. Grape seed oil is generating increased interest as a functional food product since it has been shown to contain high levels of vitamin E and unsaturated fatty acids. It is well known that oils obtained from grape by-products can be used for pharmaceutical and nutritional purposes [2]. These by-products contain some valuable substances such as fatty acids, tocopherols, sterols and sterylglycosides with potential applications in food industry mostly go to waste. On the other side, grape pressing in wineries resulted in huge amounts of grape pomace containing grape seeds that are used as a source of oil having nutritional and pharmaceutical implications [1, 2, 3, 4, 5, 6]. Tocopherols are regarded as intracellular antioxidants due to their activity in inhibiting the peroxidation of polyunsaturated fatty acids in biological membranes. Most of the commonly used vegetable oils contain only tocopherols. Commercial grape seed oil contains a relatively high quantity of the vitamin E isomers, particularly α-and γ-T3 up to about 35.2 and 78.5 mg/100g oil, respectively [7, 5, 6] The source of oils and fats is diminishing, this means that there is the growing need for the search of new sources of oil as well as exploiting sources that are currently unexploited in order to supplement the existing ones [8].

The aim of this study was to determine oil yield, fatty acid composition and tocopherol contents of oil extracted from different grape seeds collected several locations of Turkey.

2. Materials and methods

2.1.Material

The ripened grape fruits were collected from different locations and provinces of Turkey, and were separately

crushed by hand, and their pulps were removed from seeds. The seeds were washed with water and left to air-dry for 3 days. Then, the seeds were dried in atmospheric conditions. The seeds were comminuted into pieces including a previously cleaned. The dried materials were finely ground in a mortar, and the seed pieces were then stored in an air-tight container in a refrigerator (-20°C) prior to analysis.

2.2. Reagents

Petroleum ether (40-60^{o}C) was of analytical grade (>98%; 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).

2.3. Oil extraction

Grape seed oil was obtained by extraction of the meal with petroleum ether (50^{o}C) in a Soxhlet extractor for 6 h. After extraction of the oil, the solvent was evaporated under reduced pressure. The obtained oil was kept in sealed glass bottles under deep freezing (-18^{o}C) for further analysis.

2.4. Fatty Acid Composition

The fatty acid composition was determined following the ISO standard ISO 5509:2000 (ISO 2000). In brief, one drop of the oil was dissolved in 1 mL of n-heptane, 50 μg of sodium methylate was added, and the closed tube was agitated vigorously for 1 min at room temperature. After addition of 100 μL of water, the tube was centrifuged at 4500 g for 10 min and the lower aqueous phase was removed. Then 50 μL of HCl (1 mol with 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 chromotograph with a capillary column, CP-Sil 88 (100 m long, 0.25 mm ID, film thickness 0.2 μm). The temperature program was as follows: from 155 °C; heated to 220 °C (1.5^{o}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 μL. The peak areas were computed by the integration software, and percentages of fatty acid methyl esters (FAME) were obtained as weight percent by direct internal normalization.

2.5. 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 μL were injected by a Merck 655-A40 autosampler on to 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 [9].

Each method was carried out in triplicate for each sample. The mean values were given in the tables, without the standard deviation, because this value would represent only the deviation of the method and not the variation of the appropriate sample.

3. Results and discussions

3.1. Oil contents

The oil contents of grape seeds are given in Table 1. The oil contents of materials ranged between 7.9 % to 20.1 %. While the highest oil content is found in Su grape seed, the oil was established in İrikara grape seed. The crude oil contents of grape seeds were similar to those for grape seeds reported by Göktürk Baydar and Akkurt [4], Göktürk Baydar et al. [5], Ohnishi et al. [3], Schester [10] and Özcan et al. [11]. Hassanein and Abadel-Razek [2] established 12.0 % oil in grape seed. Göktürk Baydar et al. [5] reported that the oil concentration of grape seeds ranged from 12.35 % to 16.00 %. In other study, the oil level of grape seeds were found between 11.6 % to 19.6 % [3].

Table 1. *Oil contents of grape seeds (%)*

Grape names	*Oil contents, %*
At püskülü	16.4
Kozak beyazı	13.9
Söbe kara	15.6
Barinak	15.6
Dimrit siyah	17.3
Antep karasi	3.7
Isbitiren Konya	11.2
Adana beyazı	11.7
Misket	14.2
Büzgülü Gülnar	16.0
Kizil Bozkır	9.6
Göküzüm	13.0
Hönüsü siyah Antep	17.6
Kozak siyahi	16.7
Kadin parmagi beyaz	12.9
Müsgüle beyaz	18.1
Tarsus beyazi mersin	16.2
Hesapali Konya	19.7
Dökülgen Konya	12.1
Büzgülü siyah Isparta	11.6
Aküsüm Doganhisar	14.1
Gök üzüm Konya	15.3
Irikara	7.9
Tarsus beyazi Gülnar	14.3
Dimrit siyah Doganhisar	7.2
Miski Gülnar	16.0
Muftalma	13.5
Devegözü Doganhisar	16.0
Incekabuk Bozkir	14.6
Kardinal Büyükeceli	9.1
Aküzüm Konya	17.4
Büzgülü Konya	14.0
Topacik beyaz Beysehir	11.7
Recep Büyükeceli	18.2
Marcas Gülnar	13.5
Dimlit Taskent	16.3
Nazli beyaz Konya	15.7
Koz Kargicak	14.8
Hönüsü siyah Büyükeceli	17.4
Cavus beyaz Konya	18.4
Kizil üzüm Doganhisar	12.5
Isbitiren Taskent	15.0
Takara siyah Gülnar	18.1
Su üzümü Konya	20.1
Sergi Gülnar	17.7
Redglob murtici	16.6
Razaki beyaz Antep	16.6
Eksi kara Hadim	13.3
Toros beyazi Büyükeceli	17.7
Topacik siyah Konya	12.6
Karadimlit Taskent	19.9
Beylerce Denizli	12.5
Alyanak Denizli	14.7
Bogazkere Denizli	16.1
Alfons Denizli	13.1
Öküzgözü Denizli	13.9
Izazdag Denizli	12.6
Dimlit Denizli	11.7
Retglob Denizli	17.8
Soltaniye Denizli	8.6

3.2. Fatty acid contents

The fatty acid compositions of the grape seed oils extracted from sixty different grape seeds are presented in Table 2. The fatty acid composition of seed oil triacylglycerides varies widely among different plant species and often the occurrence of unusual fatty acids is characteristic for particular plant families [11]. According to the results shows in Table 3, the most predominant fatty acid of all seed

oils of grape was lineloic acid, which accounted for 58.3 % (Çavuşbeyazı) to 74.8% (Dimlit) in oils. In addition linoleic acid, seed oils grape contained higher amounts of oleic acid. The range of oleic acid was between 12.9 % (Irikara) to 27.1 % (Razaki beyaz). The seed oils of grape also contained appreciable amounts of saturated fatty acids, especially palmitic and stearic acids. In previous study, the fatty acid contents of the grape seed oils had the following range: 7.42 to 10.24 % for palmitic, 2.95 to 4.68 for stearic, 16.15 to 21.63 % for oleic, 63.33 to 71.37 % for linoleic and 0.14 to 0.35 % for linolenic acid [5]. Grape seeds were rich in oleic and linoleic acids, ranging from 17.8 to 26.5 % and 60.1 to 70.1 %, respectively [4]. Uslu and Dardeniz [12] reported that grape seed cultivars contained 8.40-6.51 % palmitic, 16.10-11.62 % oleic, 77.59-72.50 % linoleic, 3.86-3.07 % stearic acids, showing that grape oil had the quality of a good cooking oil. Özcan et al. [11] determined 4.1 % palmitic, 10.4 % stearic, 16.4 % oleic and 69.3 % linoleic acids in grape seed oil. Grape seed oil was rather poor in linolenic acid. Low levels of linolenic acid are desired in edible oils, because high levels of this fatty acid can produce an unfavourable odour and taste in oil [13, 14, 5].

The range of concentrations of the fatty acids was similar to the previous published data. The variations observed between the results of this work could be probably due to differences in climatic conditions, soil structure, localities and environmental temperature during maturation of grape seeds.

3.3. Tocopherol contents

α-T, α-T3, β-T, γ-T, β-T3, p8, γ-T3, б-T, б-T3 and total tocopherol contents of oil extracted from several grape cultivars are shown in Table 3. Generally, α-Tocopherol, α-tocotrienol and γ-tocotrienol were established at the high levels. While β-tocotrienol was not detected in the oil grape seeds (except for Toros beyazı, Topacık siyah, Beylerce Öküzgözü and Retglob grapes), γ -tocotrierol, α-tocotrierol and α-tocopherol were the most abundant tocopherol in the grape seed oils. In addition, tocopherol contents ranged from 0.8 to 26.4 for α-tocopherol, 1.4 to 36.8 for α-tocotrienol, 0.2 to 6.5 for γ -tocopherol and 5.7 to 62.6 for γ-tocotrienol in the seed oil. The seed oils of Devegözü, Beylerce, Alyanak and Öküzgözü exhibited the highest α-tocopherol values as compared to the other cultivars. On the other hand, α-tocotrierol contents of grape seed oils were found between 1.4 (Büzgülü siyah) to 36.8 (Razaki beyaz). Also, γ -tocotrienol contents ranged between 5.7 (Büzgülü siyah) to 62.6 (Kardinal). In addition, total tocopherol contents were determined between 7.8 (Büzgülü siyah) to 103.2 (Beylerce). The highest total tocopherol contents of seed oils were determined in Devegözü (89.9), Kardinal (88.1), Redglob (90.5) and Beykerce (103.2). Wie et al [6] reported that the total concentration of tocopherol and tocotrienol was in the range of 4.8-9.9 mg/ 100 g seed (35.3-68.8 mg/ 100g oil basis). The Muscat Bailey A cultivar had the highest total tocopherol and tocotrienol contents, followed by Canner and Naples. γ-tocotrienol ranged from 1.6 to 4.9 mg/100 g seed (11.2 to 53.81 mg/100 g oil basis) and was the main isomer, followed by α-tocotrienol in most of the samples [6].

Göktürk Baydar and Akkurt [4] reported that total tocopherol in grape seed oil from 18 different cultivars ranged from 32.8 to 57.8 mg/100g oil. The levels of tocopherols and tocotrienols in grape seeds are comparable with palm and bran oils based on oil content. Tocotrienols have unique physiological activities, including hypo cholesterolemic, anti-thrombotic, antiproliferative, and neuroprotective properties [15]. Grape seed oil contained 10.0 % α-tocopherol, 2.5 % γ -tocopherol, 37.5 % α-tocotrienol and 50.0

% γ-tocotrienol [2]. Göktürk Baydar et al. [5] determined 128.14-325,39 mg/kg α-tocopherol, 14.37-39.31 mg/kg γ-tocopherol 0.62-1.63 mg/kg б-tocopherol in different grape seed oils. Differences in tocopherol contents of grape seed oil are depend on genotype [4, 16].

Table 2. *Fatty acid compositions of grape seed oils (%)*

Grape name	16:0	16:1n-7	16:1n-9	18:0	18:1n-9	18:1n-7	18:2n-6	20:1n-9	18:3D9,12,15	20:1n-7	18:4D6,9,12,15	Total (%)
At püskülü	8.2	0.1	0.1	4.1	16.9	0.8	68.6	0.2	0.4	0.0	0.2	99.7
Kozak beyazi	9.1	0.2	0.1	4.7	19.8	0.2	65.2	0.2	0.0	0.4	0.2	99.9
Söbe kara	8.7	0.1	0.1	3.6	17.1	0.2	68.1	0.2	0.0	0.5	0.2	98.6
Barinak	8.2	0.2	0.1	4.3	26.4	0.3	59.4	0.2	0.0	0.3	0.2	99.5
Dimrit siyah	8.0	0.1	0.1	5.1	18.9	0.7	65.7	0.2	0.0	0.4	0.2	99.5
Antep karasi	12.1	0.3	0.3	4.8	19.6	1.2	59.2	0.2	0.6	0.0	0.2	98.5
Isbitiren Konya	7.6	0.1	0.0	4.2	17.1	0.8	69.5	0.2	0.3	0.0	0.2	99.9
Adana beyazi	8.4	0.3	0.0	5.5	17.3	0.9	66.5	0.2	0.0	0.4	0.2	99.7
Misket	7.1	0.1	0.0	4.1	17.3	0.7	69.7	0.2	0.0	0.5	0.2	99.8
Büzgülü Gülnar	8.2	0.1	0.0	3.7	16.2	0.8	70.1	0.2	0.4	0.0	0.2	99.8
Kizil Bozkir	8.3	0.1	0.0	4.7	16.4	0.7	68.8	0.2	0.4	0.0	0.2	99.8
Göküzüm	7.9	0.1	0.0	4.2	17.5	0.8	68.7	0.2	0.3	0.0	0.2	99.8
Hönüsü siyah Antep	9.6	0.2	0.0	4.3	21.8	1.1	61.8	0.2	0.4	0.0	0.2	99.4
Kozak siyahi	7.6	0.1	0.0	4.2	15.1	0.8	70.8	0.1	0.4	0.0	0.2	99.4
Kadin parmagi beyaz	8.5	0.2	0.0	5.1	20.1	0.0	65.2	0.2	0.3	0.0	0.1	99.5
Müsgüle beyaz	6.7	0.0	0.1	5.5	16.5	0.8	69.1	0.0	0.2	0.3	0.0	99.1
Tarsus beyazi mersin	7.9	0.1	0.0	5.5	18.7	0.8	66.6	0.0	0.3	0.0	0.0	100.0
Hesapali Konya	8.5	0.1	0.0	6.3	22.5	0.9	60.8	0.0	0.3	0.0	0.0	99.4
Dökülgen Konya	8.0	0.0	0.0	4.3	16.8	0.8	68.9	0.0	0.0	0.0	0.0	98.8
Büzgülü siyah Isparta	8.2	0.3	0.0	5.0	17.5	1.1	65.6	0.0	0.4	0.0	0.0	98.0
Aküsüm Doganhisar	7.2	0.1	0.0	4.5	14.2	1.0	71.5	0.0	0.4	0.0	0.2	99.1
Gök üzüm Konya	8.4	0.0	0.0	4.0	18.4	0.0	68.4	0.0	0.4	0.0	0.0	99.6
Irikara	8.3	0.1	0.0	3.5	12.9	1.3	71.2	0.2	0.0	0.0	0.0	97.6
Tarsus beyazi Gülnar	8.6	0.2	0.0	4.7	18.4	1.0	65.6	0.2	0.4	0.0	0.2	99.4
Dimrit siyah Doganhisar	7.9	0.1	0.0	4.5	13.5	0.8	72.2	0.2	0.5	0.0	0.2	99.9
Miski Gülnar	7.2	0.1	0.0	4.2	14.2	0.6	72.8	0.1	0.3	0.0	0.2	99.9
Muftalma	6.9	0.1	0.0	4.9	21.5	0.7	64.6	0.2	0.0	0.4	0.2	99.5

Table 2.

Grape name	16:0	16:1n-7	16:1n-9	18:0	18:1n-9	18:1n-7	18:2n-6	20:1n-9	18:3D9,12,15	20:1n-7	18:4D6,9,12,15	Total (%)
Devegözü Doganhisar	9.2	0.1	0.0	3.9	16.0	0.8	68.5	0.0	0.4	0.2	0.0	99.2
Incekabuk Bozkir	7.8	0.1	0.0	4.5	21.6	1.1	64.1	0.2	0.3	0.0	0.2	99.9
Kardinal Büyükeceli	8.3	0.2	0.0	3.9	15.8	0.9	68.1	0.2	0.4	0.0	0.2	97.9
Aküzüm Konya	7.8	0.1	0.0	6.4	22.4	0.8	61.4	0.2	0.3	0.0	0.2	99.7
Büzgülü Konya	7.5	0.1	0.0	4.9	15.2	0.8	70.5	0.2	0.3	0.0	0.2	99.6
Topacik beyaz Beysehir	7.4	0.1	0.0	5.1	15.4	0.7	69.9	0.2	0.4	0.0	0.2	99.5
Recep Büyükeceli	9.5	0.2	0.0	4.5	18.0	1.0	66.1	0.1	0.3	0.0	0.1	99.7
Marcas Gülnar	8.3	0.1	0.0	4.6	17.0	0.8	67.5	0.0	0.4	0.0	0.2	98.9
Dimlit Taskent	7.4	0.2	0.0	4.1	16.5	0.8	69.9	0.0	0.4	0.2	0.0	99.5
Nazli beyaz Konya	7.3	0.2	0.0	4.3	16.6	0.8	69.7	0.2	0.3	0.0	0.2	99.5
Koz Kargicak	9.6	0.2	0.0	6.2	19.7	0.8	62.6	0.2	0.4	0.0	0.2	99.9
Hönüsü siyah Büyükeceli	8.0	0.1	0.0	4.7	20.4	0.8	64.9	0.0	0.3	0.2	0.0	99.5
Cavus beyaz Konya	9.1	0.2	0.0	5.6	24.8	1.1	58.3	0.0	0.3	0.2	0.0	99.6
Kizil üzüm Doganhisar	8.2	0.1	0.0	4.8	16.6	0.9	68.1	0.0	0.4	0.2	0.0	99.3
Isbitiren Taskent	7.4	0.1	0.0	4.5	17.0	0.7	69.2	0.2	0.3	0.0	0.2	99.6
Takara siyah Gülnar	7.4	0.1	0.0	4.5	14.4	0.7	71.2	0.2	0.3	0.0	0.2	99.2
Su üzümü Konya	7.7	0.1	0.0	3.6	15.8	0.7	71.1	0.2	0.3	0.0	0.2	99.7
Sergi Gülnar	7.8	0.1	0.0	6.0	17.4	0.7	67.0	0.2	0.3	0.0	0.2	99.7
Redglob murtici	7.7	0.1	0.0	4.7	18.2	0.8	67.5	0.2	0.3	0.0	0.2	99.7
Razaki beyaz Antep	8.5	0.1	0.0	4.7	27.1	1.0	57.5	0.2	0.3	0.0	0.2	99.7
Eksi kara Hadim	7.6	0.1	0.0	5.1	13.8	0.8	71.4	0.2	0.3	0.0	0.2	99.5
Toros beyazi Büyükeceli	8.3	0.1	0.0	5.2	20.8	0.8	63.9	0.2	0.3	0.0	0.2	99.8
Topacik siyah Konya	8.0	0.1	0.0	4.0	17.5	0.8	68.4	0.0	0.4	0.0	0.2	99.4
Karadimlit Taskent	7.9	0.1	0.0	4.5	16.6	0.7	69.2	0.2	0.4	0.0	0.2	99.8
Beylerce Denizli	8.1	0.1	0.0	4.3	16.3	0.7	69.1	0.2	0.5	0.0	0.2	99.6
Alyanak Denizli	9.0	0.2	0.0	3.9	18.8	0.8	66.4	0.2	0.5	0.0	0.2	99.8
Bogazkere Denizli	7.0	0.1	0.0	5.5	22.6	0.7	63.4	0.2	0.4	0.0	0.2	99.9
Alfons Denizli	8.0	0.2	0.0	3.8	17.5	0.8	68.4	0.0	0.2	0.0	0.2	99.1
Öküzgözü Denizli	8.8	0.2	0.1	4.5	19.3	1.0	65.5	0.2	0.4	0.0	0.0	99.9
Izazdag Denizli	9.1	0.1	0.0	5.2	19.0	0.8	64.9	0.2	0.4	0.0	0.2	99.9
Dimlit Denizli	7.8	0.1	0.0	3.2	12.2	0.9	74.8	0.1	0.5	0.0	0.2	99.6
Retglob Denizli	7.7	0.1	0.0	4.2	16.6	0.8	70.0	0.0	0.3	0.0	0.2	99.9
Soltaniye Denizli	8.4	0.1	0.0	4.7	18.4	0.8	66.5	0.0	0.5	0.2	0.0	99.6

Table 3. *Tocopherol contents of grape seed oils (mg/100 g oil)*

Name	α-T	α-T3	β-T	γ-T	β-T3	P8	γ-T3	δ-T	δ-T3	Total
At püskülü	5.2	8.7	0.0	0.5	0.0	1.1	10.1	0.0	0.0	25.6
Kozak beyazi	2.1	11.0	0.0	0.6	0.0	0.8	5.7	0.0	0.0	20.3
Söbe kara	2.3	10.4	0.0	0.7	0.0	0.3	9.6	0.0	0.0	23.2
Barinak	3.6	20.5	0.0	2.0	0.0	0.5	8.5	0.0	0.0	35.0
Dimrit siyah	1.7	12.0	0.0	0.3	0.0	0.9	16.4	0.0	0.0	31.3
Antep karasi	3.2	35.3	0.0	1.8	0.0	1.0	8.1	0.0	0.0	49.5
Isbitiren Konya	3.2	9.7	0.0	0.9	0.0	0.0	19.9	0.0	0.0	33.7
Adana beyazi	7.1	21.8	0.0	1.3	0.0	0.0	31.4	0.0	0.0	61.6
Misket	7.6	9.2	0.0	1.5	0.0	1.0	26.8	0.0	0.0	46.2
Büzgülü Gülnar	6.8	15.3	0.0	0.7	0.0	0.0	25.5	0.0	0.0	48.3
Kizil Bozkir	7.6	12.5	0.0	3.1	0.0	1.3	23.4	0.0	0.0	47.9
Göküzüm	5.1	17.6	0.0	0.6	0.0	1.0	23.1	0.0	0.0	47.4
Hönüsü siyah Antep	10.2	23.8	0.0	3.0	0.0	1.4	20.5	0.0	0.0	58.8
Kozak siyahi	17.8	20.9	0.0	1.8	0.0	3.7	34.3	0.0	0.0	78.5
Kadin parmagi beyaz	7.6	22.5	0.0	0.0	0.0	1.8	16.6	0.0	0.0	48.5
Müsgüle beyaz	13.0	25.0	0.0	1.9	0.0	0.4	27.5	0.0	0.0	67.8
Tarsus beyazi mersin	13.4	16.2	0.0	2.9	0.0	2.4	26.6	0.0	0.0	61.6
Hesapali Konya	4.0	21.6	0.0	0.5	0.0	1.1	21.2	0.0	0.0	48.4
Dökülgen Konya	1.3	4.2	0.0	0.9	0.0	13.1	0.0	0.0	0.0	19.4
Büzgülü siyah Isparta	0.5	1.4	0.0	0.2	0.0	0.0	5.7	0.0	0.0	7.8
Aküsüm Doganhisar	2.0	2.6	0.0	1.6	0.0	0.0	9.9	0.0	0.0	16.1
Gök üzüm Konya	2.1	8.8	0.0	1.2	0.0	0.7	22.1	0.0	0.0	34.9
Irikara	0.8	2.7	0.0	1.7	0.0	0.0	11.2	0.0	0.0	16.4
Tarsus beyazi Gülnar	9.7	13.1	0.0	1.4	0.0	1.0	34.4	0.0	0.0	59.7
Dimrit siyah Doganhisar	7.7	7.4	0.0	2.6	0.0	0.9	20.9	0.0	0.0	39.5
Miski Gülnar	2.8	6.8	0.4	0.7	0.0	0.1	20.8	0.0	0.0	31.5
Muftalma	2.0	6.0	0.0	0.6	0.0	0.2	18.8	0.0	0.0	27.6
Devegözü Doganhisar	18.9	20.8	0.0	2.3	0.0	1.3	46.6	0.0	0.0	89.9
Incekabuk Bozkir	10.6	11.9	0.0	1.0	0.0	0.8	23.5	0.0	0.0	47.8
Kardinal Büyükeceli	5.8	18.1	0.0	1.1	0.0	0.6	62.6	0.0	0.0	88.1
Aküzüm Konya	5.0	23.6	0.0	1.0	0.0	1.1	20.1	0.0	0.0	50.8
Büzgülü Konya	1.2	2.9	0.0	0.7	0.0	0.0	26.8	0.0	0.0	31.7
Topacik beyaz Beysehir	8.8	24.2	0.0	3.4	0.0	1.2	36.7	0.0	0.0	74.3
Recep Büyükeceli	6.8	19.8	0.0	1.1	0.0	0.9	43.7	0.0	0.0	72.3
Marcas Gülnar	8.4	12.5	0.0	2.6	0.0	0.9	19.6	0.0	0.0	44.0
Dimlit Taskent	7.0	18.3	0.0	1.7	0.0	0.5	34.2	0.0	0.0	61.7
Nazli beyaz Konya	6.9	19.6	0.0	1.2	0.0	0.4	35.0	0.0	0.0	63.2
Koz Kargicak	12.6	31.1	0.0	0.2	0.0	2.2	15.0	0.0	0.0	61.1
Hönüsü siyah Büyükeceli	14.7	18.1	0.0	0.7	0.0	0.8	33.4	0.0	0.0	67.7
Cavus beyaz Konya	10.3	24.8	0.0	0.9	0.0	1.8	24.1	0.0	0.0	61.9
Kizil üzüm Doganhisar	6.7	11.6	0.0	1.3	0.0	0.0	30.1	0.0	0.0	49.7
Isbitiren Taskent	5.7	23.8	0.0	1.0	0.0	0.5	26.8	0.0	0.0	57.8

Name	α-T	α-T3	β-T	γ-T	β-T3	P8	γ-T3	δ-T	δ-T3	Total
Takara siyah Gülnar	6.1	13.0	0.0	1.8	0.0	0.6	37.8	0.0	0.0	59.4
Su üzümü Konya	3.0	14.3	0.0	1.3	0.0	0.3	35.1	0.0	0.0	54.1
Sergi Gülnar	5.3	11.4	0.0	0.6	0.0	0.9	33.4	0.0	0.0	51.6
Redglob murtici	15.5	33.7	0.0	6.5	0.0	1.6	33.2	0.0	0.0	90.5
Razaki beyaz Antep	8.7	36.8	0.0	2.3	0.0	1.1	17.4	0.0	0.0	66.3
Eksi kara Hadim	2.8	6.5	0.0	0.9	0.0	0.4	29.0	0.0	0.0	39.6
Toros beyazi Büyükeceli	2.9	17.6	0.0	1.2	0.7	0.9	31.7	0.0	0.0	55.0
Topacik siyah Konya	8.2	22.2	0.0	0.6	0.2	0.7	30.1	0.0	0.0	62.0
Karadimlit Taskent	7.2	13.0	0.0	3.5	0.0	0.6	52.8	0.0	0.0	77.2
Beylerce Denizli	26.4	23.9	0.8	3.3	0.4	2.1	43.3	0.0	3.0	103.2
Alyanak Denizli	22.0	19.1	0.0	3.5	0.0	2.2	29.2	0.0	0.0	76.0
Bogazkere Denizli	5.2	14.5	0.0	0.2	0.0	1.1	14.5	0.0	0.0	35.4
Alfons Denizli	10.0	10.3	0.0	0.5	0.0	0.9	18.4	0.0	0.2	40.4
Öküzgözü Denizli	20.8	14.4	0.0	2.3	0.4	1.0	21.2	0.0	0.7	60.7
Izazdag Denizli	9.0	13.5	0.0	2.4	0.0	1.5	17.4	0.0	0.4	44.2
Dimlit Denizli	11.6	15.3	0.1	1.3	0.0	1.7	35.6	0.0	0.8	66.3
Retglob Denizli	5.7	17.2	0.0	4.9	0.4	0.8	17.1	0.0	0.2	46.2
Soltaniye Denizli	13.7	13.9	0.0	4.0	0.0	3.1	20.4	0.0	0.2	55.3

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