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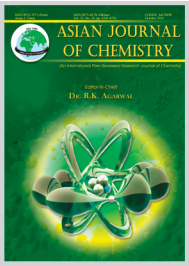

Fatty Acid Compositions of Some Popular Grape Seeds Grown in Turkey

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The present study describes the determination and comparison of fatty acid profile in seeds of four popular wine grape cultivars (Narince, Kalecik Karasi, Öküzgözü and Bogazkere) grown in Turkey. The fatty acid profile was determined using GC. 13 Fatty acids were detected in grape seed oils. The results showed that ω-6 fatty acid level of grape seed from Kalecik Karasi were higher than that of other grape cultivars.

Key Words: Vitis vinifera L., Fatty acid profile, Oil.

INTRODUCTION

Grape seed is a well known oil seed crop containing typically 8-20 % (w/w) of oil[1]. The main concern in grape seed oil is the high content of the unsaturated fatty acids such as linoleic acid (72-76 %, w/w), which is higher than those in safflower oil (70-72%), sunflower oil (60-62 %) and corn oil (52 %)[2]. Grape seeds also contain protein, carbohydrates, polyphenols, crude fibre, ash and other inorganic materials[3,4]. The oil is used chiefly for edible purposes after refining.

Grape seed oil is reputed to contain plentiful antioxidants, as well as to lower cholesterol levels, vitamins (β-carotene, vitamin E and C) and phenolic compounds[5]. 60-70 % of the polyphenols, which can be extracted from grape textures, is in the seed, 28-35 % is in the fruit skin and 10 % is in the fruit flesh[6]. Grape seed extract contains proanthocyanidins, a class of flavanols[4]. Recent studies have shown that procyanidins in grape seeds possess antioxidative, antiinflammatory, anti-arthritic and antitumor promoting activities[7] and prevent heart disease and skin aging[8].

Many species of Vitis were studied for especially volatile constituents. Some papers have been referred to volatile compounds in endemic grape samples[9,10]. Although similar studies on some grape seed cultivars in Turkey have already been performed. But, a comparative study on fatty acid profile of four popular grape seed cultivars in Turkey has not been reported so far. Determination of the fatty acid profile of these grape seed will improve the nutritional information available to consumer. Thus, the present study was carried out to determine and compare the fatty acid profile of them.

EXPERIMENTAL

The ripened grape samples were collected from four different Turkish vineyard producers, Narince (white colour wine grape), Kalecik Karasi (red colour wine grape), Öküzgözü (red colour wine grape) and Bogazkere (red colour wine grape), in 2009. Seven samples were collected from different grapevines for each cultivar. The seed was excised from product and air-dried at room temperature under shaded conditions. It was stored at room temperature until analysis.

Fatty acid analysis: Grape seed was powdered using an agate mortar after it was dried for 3 h in drying oven at 40 ºC. Seed oil was obtained by extracting it with Soxhlet extractor using diethyl ether as solvent for 8 h. The solvent removed under reduced pressure. The fatty acids were converted to corresponding methyl esters according to the previously reported method[11]. A methanolic solution of KOH (0.5 N, 3 mL) was added to 200 mg of oil in a 25 mL round bottomed flask attached to a reflux condenser. The mixture was heated to reflux for 10 min and then allowed to cool to room temperature. 2 mL of BF_3-methanol complex (14 %, w/w) was added to the mixture, it was heated to reflux for 10 minutes again and then allowed to cool to room temperature. 1 mL of heptane and 1 mL of NaCl solution (saturated) is added. Organic phase is separated with a Pasteur pipette, dried over Na_2SO_4 and filtered. At the beginning of each analysis, the samples were allowed to equilibrate to room temperature and analyzed by gas liquid chromatography (Agilent-6890N), equipped with dual flame ionization detector and a 30 m in length, 0.32 mm ID, film thickness 0.25 μm capillary DB-23 column. Column

TABLE-1
FATTY ACID PROFILES OF GRAPE SEEDS (% w/w)

Fatty acids	Narince (n = 7)	Bogazkere (n = 7)	Kalecik Karasi (n = 7)	Öküzgözü (n = 7)
C 14:0	0.08 ± 0.00a	0.07 ± 0.00a	0.08 ± 0.01a	0.04 ± 0.00b
C 16:0*	7.46 ± 0.01c	9.56 ± 0.02a	7.87 ± 0.02b	6.83 ± 0.00d
C 17:0	0.06 ± 0.00b	0.08 ± 0.00a	0.08 ± 0.00a	0.07 ± 0.00b
C 18:0	4.96 ± 0.01b	6.38 ± 0.02a	4.03 ± 0.03c	4.92 ± 0.03b
C 20:0*	0.18 ± 0.00b	0.21 ± 0.00a	0.15 ± 0.00d	0.17 ± 0.00c
C 22:0	0.06 ± 0.00b	0.05 ± 0.00b	0.14 ± 0.00a	0.04 ± 0.01b
C 24:0	0.06 ± 0.00b	0.05 ± 0.01b	0.26 ± 0.01a	0.05 ± 0.03b
Σ SFA	**12.86**	**16.40**	**12.61**	**12.12**
C 16:1	0.06 ± 0.01ab	0.05 ± 0.00b	0.07 ± 0.01a	0.05 ± 0.00b
C 17:1	0.07 ± 0.01a	0.06 ± 0.00ab	0.07 ± 0.01a	0.04 ± 0.01c
C 18:1*	17.97 ± 0.03c	27.52 ± 0.11a	15.81 ± 0.01d	23.46 ± 0.06b
C20:1	0.16 ± 0.00c	0.24 ± 0.01a	0.14 ± 0.00c	0.20 ± 0.00b
Σ MUFA	**18.26**	**27.87**	**16.09**	**23.75**
C 18:2*	67.65 ± 0.17b	54.87 ± 0.14d	70.32 ± 0.14a	63.30 ± 0.06c
C 18:3	0.32 ± 0.00c	0.26 ± 0.00a	0.47 ± 0.00a	0.38 ± 0.01b
Σ PUFA	**67.97**	**55.13**	**70.79**	**63.68**
ω6 / ω3	211.410	211.040	149.620	166.58
SFA / PUFA	0.1890	0.298	0.178	0.19
Unknown	0.910	0.600	0.510	0.45

* a–d Means that are in the same row as each other and that do share a superscript letter in common are not significantly different from each other at P < 0.05; SFA = Saturated fatty acid; MUFA = Monounsaturated fatty acid; PUFA = Polyunsaturated fatty acid.

temperature was 60 ºC for 2 min. and then raised progressively 5 ºC/min up to 250 ºC where it was maintained for 20 min at 250 ºC. The carrier gas was hydrogen (2 mL/min). The injector and detector temperatures were 230 ºC. Conditions to separate fatty acids of carbon chain length from 14 to 24 were determined. The fatty acids in samples were identified by comparison of retention times with known external standard mixtures, quantified by a HP Chem Station software and the results were expressed as percentage distribution of fatty acid methyl esters. Each of the experiments was repeated three times.

Statistical analysis: Gas liquid chromatography analyses were repeated by three times. In fatty acid analysis, seven data (n = 7) were obtained for each variety. The results are reported as means ± SD. Statistical comparisons were made using SPSS Software (version 15.0). Analysis of variance (ANOVA) was used to compare four different samples with each other. P-value < 0.05 was considered to be significant. The mean values were compared by Tukey's test.

RESULTS AND DISCUSSION

The fatty acid profiles are presented in Table-1. Thirteen fatty acids were detected for four grape cultivars. The fatty acid profiles of grape seeds were dominant by polyunsaturated fatty acids (PUFAs), which comprised about the better part (55.13-70.79 %) of the total fatty acids. The major fatty acid was found to be linoleic acid (18:2, ω6) for all samples. The high levels of linoleic acid (54.87-70.32 %) are included in the fatty acid distribution, while there was a relatively low level of linolenic acid (C 18:3, 0.26-0.47 %). An inverse correlation exists between C18:2 and C18:3 in grape seeds. The presence of linoleic acid, one of essential fatty acids, is very important factor for nutritional quality of oils. The higher linoleic acid content makes grape seed oil nutritionally more valuable. The results of the present study are in agreement with previous workers[9,12]. The fatty acid profile of some grape seeds grown in Turkey has been investigated and their linoleic acid contents were found to be between 57.13 and 59.07 %[13]. It was reported that some extracts from Syrah and Tintorera contained 64.5 and 61.4 % of linoleic acid as major fatty acid, respectively[14].

Other dominant fatty acids were oleic acid (18:1, ω9), palmitic acid (16:0) and stearic acid (18:0). Myristic acid (14:0) and arachidic acid (20:0) were present in minor amounts. The myristic acid contents were similar for all samples, while there were significant differences with respect to other fatty acids. The highest stearic acid content was found in Bogazkere, while the lowest in Kalecik Karasi. The palmitic, stearic, arachidic, oleic, gadoleic acid content in Bogazkere were notably higher than other grape seed samples.

Among monounsaturated fatty acids (MUFAs), oleic acid ranging from 15.81 % to 27.52 % was the dominant fatty acid. Demir and Namli[12] have reported that oleic acid levels were between 22 % and 34 % for diverse origins of Vitis. Demir and Otludil[15] have reported that the main MUFA in seed of three grape cultivars was oleic acid. The results clearly indicated that PUFA contents (55.13 - 70.79 %) were higher than those of MUFA (16.09-27.87 %) and saturated fatty acid (SFA) (12.12-16.4 %) for all cultivars. These findings are consistent with reports of Tangolar *et al.*[16] for Vitis varieties. They reported that PUFA, MUFA and SFA contents of grapes oils were 62.88-69.49, 18.19-23.29 and 12.01-15.10 %, respectively.

The ω-6/ω-3 ratio is a good index for comparing relative nutritional value of seed oils of four grape cultivars. Nutrition societies recommend a balanced ratio of these two types of fatty acids may be necessary for optimal health, normal development and prevention of chronic disease[17]. Due to dietetic habits, increased consumption of ω-3 has been proposed in the North American diet[18]. The ω-6 and ω-3 PUFAs of the grape cultivars accounted for 54.87-70.32 % and 0.26-0.47 % of the total

fatty acids, respectively and the ratio of ω-6/ω-3 was between 149.62 and 211.41. The ratio of ω-6/ω-3 PUFAs found in this study was higher than the value (4.0 at maximum) recommended by the UK Department of Health[19]. Similar results were obtained by Citil and Tekinsen[20] in some Orchidaceae species. However, values higher than the maximum may be evaluated only one factor on cardiovascular diseases while the presence of anti-oxidants and MUFA plays an important role as well[21].

Consequently, the fatty acid compositions of four cultivars were determined and compared. The results clearly indicate that there are differences in fatty acid compositions between them. These differences are thought to arise from latitude.

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