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# Determination of Fatty Acid Compositions of Some Raisin Cultivars in Turkey

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In this study, total fat content and fatty acid composition of 3 raisin cultivars grown in Konya in Turkey were determined by gas chromatography. Polyunsaturated fatty acids (PUFA) were found to be higher than saturated fatty acid (SFA) and monounsaturated fatty acids (MUFA) in all samples. Palmitic acid was the major saturated fatty acid (15.84-24.23 % of total fatty acids) in all samples. Oleic acid was identified as the major monounsaturated fatty acids (9.72-16.01 % of total fatty acids) in all samples. Linoleic acid was the most abundant polyunsaturated fatty acids (47.80-60.74 % of total fatty acids) in all samples. It was shown that the fatty acid composition, ω3/ω6 fatty acids ratio and SFA/PUFA ratio between the raisin samples were varied.

**Key Words: Raisin, Fatty acid composition, Oil.**

## INTRODUCTION

Grapes (*Vitis vinifera* L.) are known as one of the most important fruit crops in the world, with an approximate annual production of 68 million tons. Because Turkey is located between 36 and 42º north latitudes providing a suitable geographic position, its climate is very convenient to grape growing. According to recent statistical data, the total grapevine area in Turkey is 482.789 ha; total fresh grape production is 3.918-440 tons and crop yield is 8116.2 kg/ha[1]. Raisins are an important agricultural product with 300,000 tons produced in the Turkey in 2008. Turkey, USA, Chile, Iran, South Africa and Greece are the top producing countries[2].

In general, the composition of grapes are water, sugar, minerals, organic acids, nitrogenous agents, flavoring agents, enzymes, vitamins and phenolic compounds[3]. Food value of raisins lies chiefly in their sugars, fruit acids and mineral salts[4]. Raisins are rich in point of potassium, calcium, magnesium and phosphorus minerals[4,5]. On the other hand, raisins are rich also on account of vitamin A, thiamin, riboflavin, niacin, vitamin C, pyridoxine vitamins[5]. The glucose and fructose found in grapes and *via* direct diffusion bleeding, particularly because of pass-quality infant and children nutrition is important[6].

40 % of the grapes produced in Turkey are consumed fresh, 35 % are dried, 23 % are used in the making of various products such as molasses, dried fruit sheets and sherbet while 2 % are processed to be made wine[7]. Approximately 71 % of world grape production is used for wine, 27 % as fresh fruit and 2 % as dried fruit[8]. These species are known to have anti-inflammatory, antispasmodic, carminative, analgesic nervous system stimulant, sedative, antitussive, stomachic, anticonvulsant and antifeedant activities[9].

Among the polyunsaturated fatty acid (PUFA), linolenic acid (C18:3 n-3), EPA (eicosapentaenoic acid, C20:5 n-3) and DHA (docosahexaenoic acid, C22:6 n-3) are the dominant n-3 fatty acids in sunflower oil[10]. These fatty acids are of great importance to humans for the prevention of coronary heart disease[11]. General recommendations for daily dietary intakes of DHA/EPA are 0.5 g for infants and 1 g/day for adults[12]. ω-3 PUFA have been shown to have positive effects on cardiovascular diseases[13].

Most of the studies on *Vitis vinifera* L. varieties comprise their fatty acid composition. There is no work on the drying of *Vitis vinifera* L. cultivars. Therefore, the aim of this study was to determine the total fatty acid composition, ω3/ω6 fatty acids ratio and SFA/PUFA ratio of some raisin samples in eating.

## EXPERIMENTAL

Three raisin samples were collected from the Eastern Mediterranean Region of Anatolia in order to determine the fatty acid compositions for 7 samples from each of the 3 most widespread Eksi Kara, Gök Üzüm and Kara Dimrit. were dried. Identification of the varieties of grape collected was carried out according to the usual procedures, based on methods suggested by the method[14], at the Herbarium of the Department of Biology at Selcuk University. These samples were frozen and stored at -27 ºC until analyzed.

**Fatty acid analysis:** Fat extraction was carried out according to the AOAC. Fat (crude) was determined gravimetrically on 2 or 4 g portions of each feed composite or reference material by AOAC method 922.06[15]. Samples were transesterified with $BF_3$-methanol[16]. The resultant fatty acid methyl esters were separated and stored at -20 ºC. At the beginning of each analysis, the samples were allowed to equilibrate to room temperature and analyzed by gas liquid chromatography (Shimadzu 15-A), equipped with dual flame ionization detector and a 1.8 m × 3 mm internal diameter packed glass column containing GP 10 % SP-2330 on 100/120 Chromosorb WAW, cat No: 11851. Column temperature was 190 ºC for 31 min and then rose progressively at 30 ºC/min up to 220 ºC where it was maintained for 10 min at 220 ºC. Carrier gas was nitrogen (2 mL/min). The injector and detector temperatures were 225 and 245 ºC, respectively. Conditions were chosen to separate fatty acids of carbon chain length from 8-24. The fatty acids were identified by comparison of retention times with known external standard mixtures (Alltech), quantified by a Shimadzu Class-Vp software were expressed as percentage distribution of fatty acid methyl esters. Each of the experiments was repeated three times.

Identification of fatty acids was carried out comparing sample fatty acid methyl ester peak relative retantion times with those obtained for Alltech standarts. Results were expressed as relative percentages. All solvents and reagents were analytical grade.

**Statistical analysis:** Three raisin samples were analyzed for each parts of varieties were analyzed in triplicate. The average results of peak area are offered as means ± SD. The statistical analysis of the percentages of fatty acid was tested by analysis of variance (ANOVA) and comparisons between mean values were performed Duncan's test. Differences between means were reported as significant if $p < 0.05$.

## RESULTS AND DISCUSSION

The raisin included in this study contained fatty acids of 8-24 carbon chain lengths. Total lipid contents of the raisins obtained from Hadim district of Konya province were investigated. The lipid of raisin was found to be 1.90, 2.50 and 2.75 %, Kara Dimrit, Gök Üzüm and Eksi Kara, respectively. Similarly, Gallendar and Peng[17] found that contents of raisin were between 0.15 % and 0.25. For total lipid contents in Eksi Kara were determined higher than other samples. The oil obtained from raisin varieties is also used for coating the raisins to improve their appearance and keep them pliable[18].

In present study, the most abundant fatty acids in Eksi Kara were linoleic acid (C18:2), palmitic acid (C16:0), oleic acid (C18:1), palmitoleic acid (C16:1), stearic acid (C18:0) and linolenic acid (C18:3), at 60.74, 18.91, 9.72, 3.43, 2.84 and 1.00 %, respectively. These six fatty acids represented about the 96.64 % of total fatty acids. Similar results were observed by Guler *et al.*[19], for 22:6 (DHA), 16:0, 18:1 ω9, 16:1 ω7, 20:5 ω3 (EPA) and 18:0 in zander.

The main interest in raisin oil is the high content of the unsaturated fatty acids such as linoleic acid (72-76 %)[20]. Similarly, Parlat *et al.*[21], found that linoleic acid was the predominant fatty acid (69.08 %) in sunflower meal and corn oil (56.89 %).

Fatty acid composition of total 3 raisin in eating is shown in Table-1. In the present study, palmitic acid was the major saturated fatty acid (15.84-24.23 % of total fatty acids) in all samples similar results were obtained by Akin *et al.*[22] with 15.24 % for Eksi Kara.

TABLE-1
FATTY ACID PROFILES OF RAISIN (%, w/w)

| Fatty acids | Eksi Kara | Gök Üzüm | Kara Dimrit |
|---|---|---|---|
| C 8:0 | 0.00 ± 0.00a | 0.00 ± 0.00a | 0.00 ± 0.00a |
| C 10:0 | 0.00 ± 0.00a | 0.00 ± 0.00a | 0.01 ± 0.00a |
| C 12:0 | 0.01 ± 0.00a | 0.01 ± 0.00a | 0.01 ± 0.00a |
| C 14:0 | 0.66 ± 0.07b | 0.55 ± 0.07b | 1.03 ± 0.07a |
| C 15:0 | 0.03 ± 0.01a | 0.01 ± 0.01b | 0.02 ± 0.01ab |
| C 16:0 | 18.91 ± 0.2b | 15.84 ± 0.26c | 24.23 ± 0.26a |
| C 17:0 | 0.01 ± 0.00a | 0.03 ± 0.00a | 0.03 ± 0.00a |
| C 18:0 | 2.84 ± 0.11c | 3.51 ± 0.11b | 4.09 ± 0.11a |
| C 20:0 | 0.03 ± 0.00a | 0.00 ± 0.00a | 0.02 ± 0.00a |
| C 21:0 | 0.28 ± 0.03a | 0.32 ± 0.03a | 0.29 ± 0.03a |
| C 22:0 | 0.00 ± 0.00a | 0.00 ± 0.00a | 0.01 ± 0.00a |
| C 24:0 | 0.38 ± 0.04ab | 0.33 ± 0.04b | 0.48 ± 0.04a |
| **ΣSFA** | **23.15** | **20.60** | **30.22** |
| C 14:1 ω5 | 0.17 ± 0.01a | 0.15 ± 0.01a | 0.16 ± 0.01a |
| C 16:1 ω 7 | 3.43 ± 0.15a | 2.12 ± 0.15c | 3.05 ± 0.15b |
| C 18:1 ω 9* | 9.72 ± 0.23c | 16.01 ± 0.23a | 12.68 ± 0.23b |
| **ΣMUFA** | **13.32** | **18.28** | **15.89** |
| C 18:2 ω6* | 60.74 ± 0.69a | 56.65 ± 0.69b | 47.80 ± 0.69c |
| C 18:3 ω3* | 1.00 ± 0.12c | 2.88 ± 0.12b | 3.27 ± 0.12a |
| C 20:2 ω6 | 0.01 ± 0.00a | 0.01 ± 0.00a | 0.02 ± 0.00a |
| C 20:3 ω3 | 0.00 ± 0.00a | 0.00 ± 0.00a | 0.00 ± 0.00a |
| C 20:4 ω6 | 0.00 ± 0.00a | 0.00 ± 0.00a | 0.00 ± 0.00a |
| C 20:5 ω3 | 0.39 ± 0.04b | 0.32 ± 0.04b | 0.85 ± 0.04a |
| C 22:3 ω3 | 0.03 ± 0.01ab | 0.02 ± 0.01b | 0.04 ± 0.01a |
| C 22:4 ω6 | 0.01 ± 0.00a | 0.02 ± 0.00a | 0.02 ± 0.00a |
| C 22:5 ω3 | 0.35 ± 0.03b | 0.32 ± 0.03b | 0.64 ± 0.03a |
| C 22:6 ω3 | 0.60 ± 0.08a | 0.55 ± 0.08a | 0.60 ± 0.08a |
| **ΣPUFA** | **63.13** | **60.77** | **53.28** |
| Σω 3 | 2.37 ± 0.12c | 4.09 ± 0.12b | 5.40 ± 0.12a |
| Σω 6 | 60.76 ± 0.41a | 56.68 ± 0.41b | 47.84 ± 0.41c |

*[a-c]Mean values within the same row sharing a common superscripts are not significantly different at $p < 0.05$.

The highest value of the saturated fatty acid (SFA) to polyunsaturated fatty acid (PUFA) ratio was present in Kara Dimrit. The SFA/PUFA value in Kara Dimrit was around 0.57. The highest total saturated fatty acid content (30.22 %) was found in Kara Dimrit. Similar results were obtained by Tangolar *et al.*[23] for Razaki, Öküzgözü, Horoz karasi, Narince; 0.21, 0.22, 0.23, 0.19, respectively.

Oleic acid was identified as the major monounsaturated fatty acid (MUFA) (9.72- 16.01 % of total fatty acids) in all samples (Table-1). Tangolar *et al.*[23] found smilar results for Razaki (19.06 %), for Öküzgözü (19.33), for Horoz Karasi (20.13 %), for Narince (20.53), for Navas[24], for syrah (22.2 %) and for Tintorera (24.9 %).

Linoleic acid (LA) was the most abundant polyunsaturated fatty acid (PUFA) (47.80-60.74 %) in all samples. Similar results were obtained by Demir and Namli[25] in Mazmura varieties. Navas[24] for Syrah (64.5 g/100 g of fatty acids), for Tintorera (61.4 %), Pardo *et al.*[26] for Syrah (64.53 %) and Monastrell (66.84 %), respectively.

Consumption of n-3 fatty acids may prevent the development of coronary heart disease[27]. In the present study, Eksi Kara Gök Üzüm and Kara Dimrit contained the highest levels of ω-6 fatty acids. These concentrations found were 60.76, 56.68 and 47.84 % for Eksi Kara, Gök Üzüm and Kara Dimrit, respectively. In the present trial, the values for ω-6/ω-3 ratio were higher than 4. This ratio was 25.64, 13.82 and 8.84, in Eksi Kara, Gök Üzüm and Kara Dimrit, respectively.

## Conclusion

It was determined that fatty acid compositions varied between raisin samples. While Kara Dimrit variety contents the least Σω 6, the same variety contents the most Σω 3 among the other cultivars. When Eksi Kara variety contents the most Σω 6, the same variety contents the least Σω 3 among the other cultivars. Unsaturated fat content was determined the highest level (79.05 %) in Gök üzüm variety. Further researches are needed to determine fatty acid composition of human fed this raisin.

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