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Short Communication

Lipid and fatty acid composition of wild and cultivated red raspberry fruits (*Rubus idaeus* L.)

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Red raspberry (*Rubus idaeus* L.) is an economically important berry crop which contains a high number of bioactive compounds with potential health benefits. Wild raspberries are traditionally a part of the Turkish diet, since it's very abundant in the northern parts of Turkey. In the present study, the lipid and fatty acid composition of wild grown and cultivated red raspberry fruits was analyzed. The yield of lipid ratio was between 0.40% (ERZ9) and 0.63% (Heritage) indicating cultivated raspberry had higher lipid ratio than all wild materials. Fatty acid analysis has shown that the eleven red raspberry genotypes and one cultivar studied contained 10 major compounds, and statistically important differences ($p < 0.05$) was observed among genotypes on C16:0, C18:1, C18:2 and C18:3. Linoleic acid (42.18 - 52.61%) and linolenic acid (17.83 - 24.10%) was the main fatty acids for all genotypes used in the present study.

Key words: Raspberries, fatty acids, wild.

INTRODUCTION

The genus *Rubus* contains a large number of highly variably and heterogeneous species, which occur in all parts of the world except the dessert regions (Jennings et al., 1990). *Rubus idaeus*, red raspberry, is supposedly named after the region near Mount Ida in Asia Minor where they grew wild and were called 'Ida' fruit by the ancient Greeks. Red raspberries are the most widely grown, while black raspberries are popular only in certain regions of the eastern USA. The progeny of black and red raspberries have purple fruits and canes; these types are popular in eastern North America. Yellow-fruited *Rubus idaeus*, caused by a recessive mutation, is also grown on a limited scale for specialty markets. *Rubus occidentalis* genotypes with yellow fruit are not grown commercially (Jennings, 1988).

Raspberries have been eaten fresh for thousands for years. Medicinal uses of raspberries are frequently found in the literature, with references to raspberry leaf tea dating to the 16th century. In the early 1900s, black raspberry juice was extracted, concentrated, and used as an edible dye for foodstuffs, such as meat. Raspberries were were also dehydrated for long-distance transport. Today, raspberry fruits are either harvested by hand and eaten fresh or machine-harvested and processed. Raspberry juice is usually blended with apple, pear, or grape juice because the flavor is too intense for direct consumption. Recently, the demand for fruit wines has increased, and raspberries make one of the better wines. Some wineries add raspberry juice to grape wine to obtain a less expensive raspberry-flavored wine. The popularity of raspberries continues to grow as many raspberry-containing products are now on supermarket shelves (Jennings et al., 1990).

Raspberries are very rich sources of bioactive compounds such as phenolics, anthocyanins, organic acid etc. Bioactive compounds of raspberry fruits, their characterization and utilization in functional foods and clinical assessment of antimicrobial properties for human health are among the major targets of contemporary research. The evaluation of raspberry fruit genetic resources for the presence of bioactive compounds and their properties as natural agents is of doubtless significance and will be with great benefit for breeders, food and pharmaceutical industry (Badjakov et al., 2008).

Although there are some studies related to lipid and fatty acid content of red raspberry fruits to evaluate the potential use of these berry lipid in food products

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(Kafkas et al., 2008; Parry et al., 2005), there have been no comparative studies related to lipid and fatty acid content of wild and cultivated red raspberry fruits. Therefore this study is the first in this area comparing wild and cultivated red raspberry fruits in terms of lipid and fatty acid composition.

Here we report on the lipid and fatty acid compositions of eleven pre selected wild grown (ERZ1, ERZ2, ERZ3, ERZ4, ERZ5, ERZ6, ERZ7, ERZ8, ERZ9, ERZ10, ERZ11) and one cultivated raspberry (Heritage cultivar).

MATERIAL AND METHODS

Material

In this study eleven previously selected wild (ERZ1, ERZ2, ERZ3, ERZ4, ERZ5, ERZ6, ERZ7, ERZ8, ERZ9, ERZ10, ERZ11) and one raspberry cultivar (Heritage) were used. The wild raspberry fruits were harvested from natural habitat near Ispir and Uzundere towns which belongs to Erzurum city in Turkey. Heritage cultivar was harvested in raspberry experiment in Ataturk University. The experiment was designed as a complete randomized block with three replicate. 20 fruits were used in each replicate. The fruits of experimental genotypes were harvested at commercial maturation stages then immediately extracted for lipid and fatty acid analysis.

Method

Lipid extraction: Lipid extraction was carried out according to Bligh and Dyer (1959). Boron trifluoride/methanol was used for the preparation of fatty acid methyl esters (AOAC, 1990).

Gas chromatographic condition: The fatty acid composition was analysed by GC Clarus 500 with autosampler (Perkin Elmer, USA) equipped with a flame ionization detector and a fused silica capillary SGE column (30 m × 0.32 mm, ID × 0.25 µm, BP20 0.25 UM, USA). The oven temperature was 140℃, held 5 min, raised to 200℃ at a rate of 4℃/min and to 220℃ at a rate of 1℃/min, while the injector and the detector temperature were set at 220℃ and 280℃, respectively. The sample size was 1 µl and the carrier gas was controlled at 16 ps. The split ratio was 1:100. Fatty acids were identified by comparing the retention times of FAME with a standard components FAME mixture (Supelco). Triplicate GC analyses were performed and the results were expressed in GC area percentage as a mean value.

Statistical analysis

The experiment was a completely randomized design with five replications. Data were subjected to analysis of variance (ANOVA) and means were separated by Duncan multiple range test at $P<0.05$ significant level.

RESULTS AND DISCUSSION

The lipid and fatty acid composition of the fruits was analyzed according to a previous method (Bligh and Dyer, 1959; AOAC, 1990), and the results are given in Table 1. The yield of lipid ratio was between 0.40% (ERZ9) and0.63% (Heritage) indicating cultivated raspberry had higher lipid ratio than all wild materials (Table 1).

Previously, total lipid content of raspberry fruits were found between 0.29 - 0.71% (Kafkas et al., 2008) which supports our present findings. Leila et al., (2007) showed that under unfavorable growing conditions, sesame seeds had lower lipid content. This findings is also support our result.

Fatty acid analysis has shown that the eleven red raspberry genotypes and one cultivar studied contained 10 major compounds, and statistically important differences ($p < 0.05$) was observed among genotypes on C16:0, C18:1, C18:2 and C18:3 (Table 1). Linoleic acid (42.18 - 52.61%) and linolenic acid (17.83 - 24.10%) was the main fatty acids for all genotypes used in present study (Table 1). In previous studies conducted on mulberry, red raspberry, marionberry, boysenberry and blueberry, the main fatty acids were found to be linoleic and linolenic acids (Kafkas et al., 2008; Parry et al., 2005; Ercisli and Orhan, 2007), in agreement with our present study. It was interesting that, all wild grown raspberry genotypes had higher amount of linoleic, palmitic and stearic acid than cultivated one.

However, the cultivated raspberry had higher oleic acid content than wild materials. Wild grown and cultivated samples did not show significant differences with respect to C14:0, C16:1, C18:0, C20:1 and C20:3 (Table 1). Ayaz et al. (1997) revealed that linoleic and palmitic acid content of wild grown cherry laurel fruits were found higher than cultivated plants. A high content of linoleic and linolenic acid (polyunsaturated fatty acids) is favorable for medicinal (prophylaxis and treatment of arteriosclerosis, eczema) and nutritional applications since these components particularly linolenic acid, are responsible for cardioprotective, antidiabetic, and antimicrobial activities (Das, 2000; Kato et al., 2000; Worm and Henz, 2000).

Fatty acid components representing about 89.28% (ERZ6) to 97.88% (ERZ1) of total lipid were characterized. ΣPUFA in the lipid from samples are the predominant constituents between 66.99% (Heritage) and 75.91% (ERZ10), and followed by ΣMUFA (12.09%, ERZ8 and 17.13%, Heritage) and ΣSFA (5.97%, ERZ10 to 9.73%, ERZ1), respectively. Previously ΣPUFA was reported predominant fatty acids in red raspberry (62.85 - 85.5%) (Kafkas et al., 2008; Parry et al., 2005).

Conclusion

The present study revealed that eleven wild selected red raspberry genotypes and one cultivar studied contained 10 major fatty acids. Linoleic acid and linolenic acid was the main fatty acids for all genotypes. All wild grown raspberry genotypes had higher amount of linoleic, palmitic and stearic acid than cultivated one suggesting the importance of these wild materials for future breeding studies to incorporate these fatty acids in new cultivars.

Table 1. Lipid percentage and fatty acid composition of red raspberry genotypes.

	Genotypes											
	ERZ1	ERZ2	ERZ3	ERZ4	ERZ5	ERZ6	ERZ7	ERZ8	ERZ9	ERZ10	ERZ11	Heritage
% lipid	0.41ab	0.47ab	0.44ab	0.52ab	0.43ab	0.51ab	0.47ab	0.50ab	0.40b	0.44ab	0.47ab	0.63a
C14:0	0.27^{NS}	0.33	nd	0.12	nd	nd	0.15	0.22	nd	nd	nd	0.13
C16:0	8.31b	7.44c	7.62bc	5.87e	6.76d	7.41c	9.14a	7.08cd	6.15de	6.40de	5.97de	4.93f
C18:0	1.15^{NS}	0.67	nd	nd	1.07	1.01	nd	nd	1.11	1.02	nd	1.18
∑SFA	9.73b	8.44ab	7.62ab	5.99ab	7.83ab	8.42ab	9.29ab	7.30ab	7.26ab	7.42ab	5.97a	6.24ab
C16:1	1.28^{NS}	1.42	0.91	0.86	1.22	0.67	0.94	0.83	1.17	1.15	1.47	0.54
C18:1	13.20ab	11.45ab	14.22ab	14.60ab	12.28ab	11.45ab	11.62ab	10.78b	12.12ab	11.31ab	12.86ab	16.14a
C20:1	0.23^{NS}	0.35	0.26	0.19	0.37	0.45	0.42	0.33	0.22	0.25	0.32	0.45
C24:1	nd^{NS}	nd	0.09	0.17	nd	nd	nd	0.15	0.09	nd	nd	nd
∑MUFA	14.71ab	13.22ab	15.48ab	15.82ab	13.87ab	12.57ab	12.98ab	12.09b	13.60ab	12.71ab	14.65ab	17.13a
C18:2	51.13ab	49.42ab	52.61a	46.13b	50.83ab	49.72ab	48.83ab	46.30b	45.76bc	50.63ab	50.40ab	42.18c
C18:3	21.40bc	24.01a	19.22cd	24.10a	19.10cd	17.83d	18.40cd	22.40b	24.07a	23.81ab	20.17c	23.30ab
C20:3	0.91^{NS}	0.72	1.04	1.62	0.86	0.74	1.22	1.62	1.69	1.47	1.53	1.51
∑PUFA	73.44ab	74.15ab	72.87ab	71.85ab	70.79b	68.29bc	68.45bc	70.72b	71.52ab	75.91a	72.10ab	66.99c
∑	97.88	95.81	95.97	93.66	92.49	89.28	90.72	90.11	92.38	96.04	92.72	90.36

NS: Not significant; nd: not determined. Data are expressed in percentage of relative fatty acids (%).

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