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Fatty Acid and Tocopherol Contents of Several Seed Oils

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The oil content of seeds ranged from 14.4 [sumac (*Rhus coriaria*) Siirt] % to 49 (Californium) % of the dry weight. The fatty acid composition of each rape and canola seed oils have the typical fatty acid composition for conventional rape and canola seed including 3.7-24.3 % of palmitic acid in addition to stearic acid (1.4-5.7 %), oleic acid (11.5-61.5 %), linoleic acid (16.7-75 %) and linolenic acid (0.1-9.9 %) as main components. The total fatty acids compositions of seed oils varied between 95.3 % (Sunflower Aydin202) to 99.9 % (Smart). As shown, the major tocopherol in the seed oils of rape and canola cultivars were α-tocopherol (3.4-56.3 %) and γ-tocopherol (0.2-32.7 %) accompanied by α-tocotrienol (0.0-4.8 %) and p8 (0.0-2.9 %).

Keywords: Seed, Oil content, Fatty acid, Tocopherol, GC, HPLC.

INTRODUCTION

Rape seed (*Brassica napus* L.) is the most important oil seed crop of the temperate climates and it takes the second place for the world supply of vegetable oil[1]. Virgin rape seed oil is a high acceptance level by the consumer, due to its careful processing, natural compositions and typical taste and smell[2]. The only crucifer oils important in commerce are rape seed and mustard seed oils, which are used primarily as edible oils but also to some extent in a number of industrial applications[3]. In recent years, considerable effort has been put into the development of models for rape seed. However, none of these developed so far has performed satisfactorily in predictions concerning biomass and yield[4]. Severel species of cruciferae presently have great commercial value as oil crops, *e.g.*, *Brassica napus*, *B. campestris* and *Sinapis alba*[5]. Recently, several studies on sunflower, sufflower, sumac and rape seed oils are reported. The aim of this study is to determine oil content, fatty acid composition and tocopherol contents of several seeds oil.

EXPERIMENTAL

Seeds were obtained from several locations of Turkey. The oil content was determined according to the method ISO 659:1998[9]. The fatty acid composition was determined following the ISO standard ISO 5509:2000[10]. The peak areas were computed by the integration software and percentages of fatty acid methyl esters (FAME) were obtained as weight per cent by direct internal normalization. Fatty acid composition of oils was performed using a gas chromatography-HP) equipped with a fused-slica capillary column (60 m × 0.32 mm, 1.2 µm film). The oven was heated from 120 to 240 °C by 20 °C/min and held for 20 min, while the injector and the flame-ionization detector (FID) were maintained at 250 °C. Injector and detector temperatures were 240 and 250 °C, respectively. 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[11].

RESULTS AND DISCUSSION

Seeds belonging to Cruciferae family were evaluated with respect to oil content, fatty acid and tocopherol profiles. The total oil contents of rape and canola seeds are given in Table-1. The oil content of seeds ranged from 14.4 % (sumac (*Rhus coriaria*) Siirt) to 49 % (californium) of the dry weight. Similar results (43.20-48 %) were obtained by Mikolajczak *et al.*[3] and Gül *et al.*[1]. Regarding the economic aspects of oilseed production, a high oil content is important for the utilization of seeds. Also, some genotypes of *Brassica juncea* had high oil content, *e.g.*, RBJ-03046 (39.79 %). The highest oil content (40.7 %) was also recorded in RBN-03255 (*B. napus*), while the lowest oil content (less than 36 %) was measured in genotypes RBN-03060 (*B. napus*) and RBJ-99026 (*B. juncea*[6]).

TABLE-1.
OIL CONTENT AND FATTY ACID COMPOSITION OF SEED OILS (%)

Samples	Oil	14:0	16:0	16:1D7	16:1D9	17:0	17:1	18:0	18:1D9	18:1D11	18:2	18:3	20:0	20:1	20:2	22:0	22:1	24:0	24:1	Total
Brassica napus																				
Licosmos	47.8	0.0	3.8	0.0	0.2	0.0	0.1	1.9	58.2	3.3	18.5	9.6	0.6	1.6	0.1	0.3	0.7	0.1	0.2	99.2
Es hydromal	48.5	0.1	4.9	0.0	0.2	0.0	0.1	1.5	56.4	3.0	21.9	8.3	0.5	1.2	0.1	0.3	0.2	0.1	0.1	98.9
Jura	42.4	0.0	4.0	0.0	0.2	0.0	0.1	1.8	55.3	3.2	20.9	9.0	0.6	1.8	0.1	0.3	1.0	0.1	0.2	98.6
Gladiator	49.6	0.0	4.1	0.0	0.2	0.0	0.1	1.8	56.9	3.5	19.6	9.9	0.6	1.2	0.1	0.3	0.1	0.1	0.2	98.7
Smart	45.9	1.3	4.6	0.0	0.2	0.0	0.1	2.0	60.5	3.5	17.8	8.0	0.2	1.1	0.1	0.2	0.1	0.1	0.1	99.9
Bristol	32.9	0.1	4.9	0.1	0.2	0.0	0.1	1.8	58.0	3.0	19.9	8.2	0.6	1.2	0.1	0.4	0.1	0.1	0.1	98.9
Californium	49.0	0.1	4.3	0.0	0.2	0.1	0.1	1.8	58.8	3.4	19.4	8.4	0.3	1.1	0.1	0.3	0.2	0.1	0.1	98.8
Dase	47.5	0.0	4.4	0.0	0.2	0.0	0.1	2.2	61.5	2.9	18.2	7.0	0.6	1.0	0.1	0.3	0.0	0.1	0.1	98.5
Elvis	46.4	0.1	4.8	0.0	0.2	0.0	0.1	1.7	57.5	3.2	20.3	8.2	0.6	1.1	0.1	0.3	0.1	0.1	0.1	98.5
Nelsen	47.7	0.1	4.8	0.0	0.3	0.0	0.1	1.8	58.1	3.5	19.7	7.8	0.6	1.0	0.1	0.3	0.0	0.1	0.1	98.4
Es astrid	37.9	0.1	5.2	0.0	0.2	0.1	0.1	1.7	52.9	3.3	23.2	8.6	0.6	1.3	0.1	0.3	0.5	0.1	0.1	98.4
Olphi	48.6	0.0	4.5	0.0	0.2	0.0	0.1	1.8	59.8	3.7	16.7	8.5	0.6	1.1	0.1	0.3	0.0	0.1	0.1	97.6
Capitol	48.4	0.0	3.7	0.0	0.2	0.0	0.1	1.4	57.0	3.5	19.6	9.7	0.5	1.1	0.1	0.3	0.0	0.1	0.1	97.4
EGC 102	48.1	0.1	5.0	0.1	0.2	0.1	0.1	1.5	52.3	3.5	22.9	9.6	0.5	1.0	0.1	0.2	0.0	0.1	0.1	97.4
MHGRO-58	43.7	0.0	4.4	0.0	0.2	0.1	0.1	1.7	59.4	3.7	17.4	7.3	0.6	1.1	0.1	0.3	0.0	0.1	0.1	96.6
Licrown	47.8	0.0	4.0	0.0	0.2	0.0	0.1	1.4	56.6	3.6	19.4	8.9	0.5	1.2	0.1	0.2	0.0	0.1	0.1	96.4
Esnectar	42.6	0.1	5.7	0.1	0.3	0.1	0.1	1.5	51.2	4.0	21.9	9.3	0.6	1.1	0.1	0.3	0.0	0.1	0.1	96.6
Rhus coriaria (Kahraman Maras)	28.5	0.2	21.8	0.1	0.5	0.1	0.0	2.2	47.8	2.4	22.8	0.8	0.2	0.3	0.0	0.1	0.0	0.1	0.0	99.4
Rhus coriaria (Balikesir)	21.2	0.1	24.3	0.0	0.3	0.0	0.0	2.6	47.8	1.7	20.9	0.8	0.3	0.2	0.0	0.1	0.0	0.1	0.0	99.2
Rhus coriaria (Gaziantep)	18.3	0.1	21.9	0.1	0.2	0.0	0.0	2.8	53.4	1.7	17.1	0.6	0.4	0.3	0.0	0.1	0.0	0.1	0.0	98.8
Rhus coriaria (Siirt)	14.4	0.1	23.2	0.1	0.2	0.1	0.0	2.8	49.8	1.7	18.3	1.0	0.4	0.3	0.0	0.1	0.4	0.1	0.0	98.6
Helianthus annuus 2517	48.9	0.1	7.4	0.0	0.2	0.0	0.0	5.7	19.3	0.7	59.9	0.1	0.4	0.1	0.0	0.8	0.0	0.3	2.5	97.5
Helianthus annuus Aydin 202	43.2	0.0	4.3	0.0	0.1	0.0	0.0	4.2	36.3	0.4	45.5	0.1	0.3	0.2	0.0	0.9	0.0	0.3	2.7	95.3
Helianthus annuus Viniimik	46.3	0.1	5.4	0.0	0.1	0.1	0.0	5.1	36.3	0.5	45.7	0.1	0.4	0.1	0.0	0.8	0.0	0.3	1.2	96.2
Carthamus tinctorius L remzibey	31.5	0.1	5.9	0.1	0.1	0.0	0.0	2.0	46.3	0.7	42.4	0.1	0.4	0.3	0.0	0.3	0.0	0.2	0.5	99.4
Carthamus tinctorius L Dincer	26.7	0.1	6.8	0.0	0.1	0.0	0.0	2.1	13.3	0.7	72.2	0.1	0.4	0.2	0.0	0.3	0.0	0.1	1.7	98.1
Carthamus tinctorius L ABD	34.9	0.1	6.3	0.0	0.1	0.0	0.0	2.1	11.5	0.6	75.0	0.1	0.3	0.2	0.0	0.2	0.0	0.1	1.7	98.3

TABLE-2
TOCOPHEROL CONTENTS OF SEVERAL SED OILS (mg/100g)

Sample	α-Toco-pherol	α-Toco-trienol	β-Toco-pherol	γ-Toco-pherol	β-Toco-trienol	P8	γ-Toco-trienol	Δ-Toco-pherol	Δ-Toco-trienol	Total
Brassica napus										
Licosmos	3.4	0.6	0.0	11.9	0.0	0.5	0.0	0.3	0.0	16.7
Es hydromal	18.5	1.0	0.1	30.3	0.0	2.1	0.0	0.6	0.0	52.6
Jura	13.2	0.9	0.1	30.6	0.0	2.1	0.0	0.7	0.0	47.6
Gladiator	11.4	0.9	0.1	32.7	0.0	2.1	0.1	0.8	0.0	48.1
Smart	15.0	1.2	0.1	22.9	0.0	2.3	0.1	0.7	0.0	42.3
Bristol	14.3	1.5	0.1	29.7	0.0	1.9	0.1	0.6	0.0	48.2
Californium	14.6	0.8	0.1	29.4	0.2	1.9	0.0	0.6	0.0	47.6
Dase	18.6	0.8	0.1	31.6	0.2	2.1	0.1	0.7	0.0	54.2
Elvis	15.8	0.8	0.1	30.5	0.0	2.6	0.0	0.7	0.0	50.5
Nelsen	18.5	0.7	0.1	29.4	0.0	2.4	0.0	0.8	0.0	51.9
Es astrid	20.6	0.6	0.2	32.1	0.2	2.6	0.0	1.0	0.0	57.3
Olphi	25.2	3.1	0.1	26.8	0.1	2.0	0.1	0.4	0.0	57.8
Capitol	16.8	2.2	0.1	29.7	0.0	1.6	0.0	0.6	0.0	51.0
EGC 102	26.2	0.0	0.5	0.2	30.8	2.1	0.0	0.8	0.0	60.6
MHGRO-58	21.1	0.0	0.1	27.2	2.3	0.0	0.0	0.7	0.0	51.4
Licrown	18.8	1.8	0.1	29.2	0.0	2.0	0.0	0.6	0.0	52.5
Esnectar	30.5	2.1	0.2	27.2	0.0	2.2	0.0	0.8	0.0	63.0
Rhus coriaria (Maras)	15.4	4.8	0.0	7.7	0.0	2.9	4.1	0.8	0.2	35.9
Rhus coriaria (Balikesir)	13.1	3.9	0.3	5.0	0.0	1.2	2.4	0.7	1.0	27.6
Rhus coriaria (Gaziantep)	8.6	3.6	0.0	2.6	0.0	1.1	1.2	0.2	0.0	17.3
Rhus coriaria (Siirt)	20.6	1.0	0.1	2.6	0.0	2.6	1.2	0.0	0.0	28.1
Helianthus annuus 2517	42.8	0.0	2.5	0.4	0.0	0.3	0.2	0.2	0.0	46.4
Helianthus annuus Aydin 202	50.2	0.0	1.3	0.4	0.0	0.3	0.0	0.1	0.0	52.3
Helianthus annuus Viniimik	38.2	0.0	0.6	0.0	0.0	0.3	0.1	0.0	0.0	39.2
Carthamus tinctorius L remzibey	56.3	0.0	0.9	0.4	0.0	0.4	0.4	0.0	0.0	58.4
Carthamus tinctorius L Dincer	54.8	0.0	0.8	0.0	0.0	0.4	0.4	0.0	0.0	56.4
Carthamus tinctorius L ABD	53.9	0.6	0.8	0.3	0.0	0.3	0.2	0.0	0.0	56.1

The fatty acid composition of each rape and canola seed oils are presented in Table-1. As shown in Table-1, both have the typical fatty acid composition for conventional rape and canola seed including 3.7-24.3 % of palmitic acid in addition to stearic acid (1.4-5.7 %), oleic acid (11.5-61.5 %), linoleic acid (16.7-75 %) and linolenic acid (0.1-9.9 %) as main components. The total fatty acids compositions of seed oils varied between 95.3 % (Sunflower Aydin202) to 99.9 % (Smart). Tsevegsuren *et al.*[7] established 12-60 % oleic, to 22 % linoleic and 8.4-11.9 % linolenic acids in some rapeseed cultivars in Mongolia. Gül *et al.*[1] determined 56.92-65.71 % oleic acid and 9.55-11.97 % linolenic acid in winter rapeseed grown in Çanakkale province in Turkey. Przybylski and Mag[8] reported that canola oil contained 3.6 % palmitic acid, 1.5 % stearic acid, 61.6 % oleic acid, 21.7 % linoleic acid and 9.6 % linolenic acid. The results of tocopherol analyses of each crude oil are summarized in Table-2. As shown, the major tocopherol in the seed oils of rape and canola cultivars were α-tocopherol (3.4-56.3 %) and γ-tocopherol (0.2-32.7 %) accompained by α-tocotrienol (0.0-4.8 %) and p8 (0.0-2.9 %). Przybylski and Mag[8] reported that canola oil contained 272 mg/Kg α-tocopherol, 423 mg/Kg γ-tocopherol and 75 mg/Kg P8. Differences at the oil properties could be due to geographical location, harvesting period, environmental and analytical conditions. The composition of the oil is comparable to other commonly used oils or fats, such as olive, peanut, sunflower and therefore, the use of the oil in nutrition or technical applications is possible.

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