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Original Research Article

Fatty Acid Composition of the Aerial Parts of Some *Centaurea* Species in Elazıg, Turkey

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Abstract

Purpose: *To evaluate the fatty acid composition of six Centaurea species, viz, Centaurea behen, C. saligna, C. depressa, C. urvillei subsp. urvillei, C. urvillei subsp. hayekiana and C. aggregata subsp. aggregata, from Elazıg, Turkey.*
Methods: *Fatty acid methyl esters (FAMEs) of the oil extracts of four Centaurea species were prepared. The fatty acid compositions of Centaurea species were analyzed by gas chromatography (GC).*
Results: *Saturated fatty acids (SFAs) in Centaurea species and subspecies ranged from 24.61 - 50.92% of their total fatty acid content, while monounsaturated fatty acids (MUFAs) were in the range of 3.40 - 37.96% and polyunsaturated fatty acids (PUFAs) 12.21 - 20.57%. Palmitic acid C 16:0, oleic acid C 18:1 ω9 and linoleic acid C 18:1 ω3 were the major fatty acids in all the species. Oleic acid was the main constituent of C. urvillei subps. urvillei and C. agrregata subsp. aggregata with a content of 26.92 and 50.92%, respectively.*
Conclusıon: *The oil extracted from Centaurea species is a good source of essential fatty acids.*

Keywords: *Centaurea, Fatty acid, Palmitic acid, Oleic acid, Linoleic acid*

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INTRODUCTION

Centaurea genus, 114 of which are endemic, is represented with 192 taxa in Turkey [1-3]. It is known as “peygamber çiçeği, zerdali dikeni, coban kaldiran, timur dikeni” in Turkey [3,4]. Many species of this genus have traditionally been used for their anti-rheumatic, diuretic, choleretic, stomachic, astringent, cytotoxic, antibacterial, antipyretic and tonic properties [4-6]. Flavonoids, steroids, volatile constituents, sesquiterpene lactones and fatty acids have been previously isolated from plants belonging to the genus [7-11]. Fatty acid, either saturated or unsaturated, is a carboxylic acid with a long aliphatic chain. Most naturally occurring fatty acids have an even numbered chain of carbon atoms ranging from 4 to 28. Fatty acids that have carbon–carbon double bonds are known as unsaturated fatty acids whereas acids without double bonds are known as saturated fatty acids. They differ in chain length as well [12]. The fatty acid profiles of some plants from Turkey have previously been reported [13,14].

However there have been no reports on the fatty acid composition of *Centaurea behen* L, *C. saligna* (C. Koch.) Wagenitz, and *C. aggregata* Fish & Mey. Ex. DC. *aggregata*. In addition to the foregoing species, the fatty acid composition of *C. urvillei* DC. subsp. *urvillei* DC., *C. urvillei* DC. subsp. *hayekiana* Wagenitz. and *C. depressa*

Bieb which were previously investigated [15] were also comparatively analyzed in the present study. Therefore this study was designed to evaluate the fatty acid compositions of six *Centaurea* species, one of which (*C. saligna*) is endemic for Turkey.

EXPERIMENTAL

Plant materials

The aerial parts of *Centaurea behen, C. saligna, C. depressa*, *C. urvillei* subsp. *urvillei, C. urvillei* subsp. *hayekiana* and *C. aggregata* subsp. *aggregata*, were collected in July 2011 from Elazıg, Turkey. The plants were identified by Ugur Cakilcioglu (Elazığ Directorate of National Education, Elazığ, Turkey). Voucher specimens (nos. 1469, 1466, 1462, 1460, 1463, and 1458, respectively) were deposited in the Herbarium of Faculty of Pharmacy, Department of Pharmacognosy, Ege University, Izmir, Turkey.

Extraction of oil

The oil in the dried and powdered aerial parts (40 g) was extracted by Soxhlet extractor using petroleum ether (400 ml) at 60^{o}C for 6 h. The solvent was evaporated in a rotary evaporator, and the oil obtained was esterified to determine fatty acid composition. The fatty acids in the total lipid were esterified into methyl esters by saponification with methanol (50%) containing 5% sodium hydroxide at 100^{o}C for 10 min and transesterified with 14% v/v boron trifluoride (BF_3) in methanol at 100^{o}C for 5 min [16].

Preparation of fatty acid methyl esters (FAMEs)

The fatty acids in the total lipid were esterified into methyl esters by saponification with 0.5N methanolic NaOH and transesterified with 14% v/v BF_3 in methanol at 100^{o}C for 5 min [17].

Fatty acid analysis

The fatty acid methyl esters (FAMEs) were analyzed on a Hewlett Packard Agilent 6890 N gas chromatograph (GC), equipped with a flame ionization detector (FID) and fitted to a Supelco SP-2380 fused silica capillary column (60 m, 0.25 mm i.d. and 0.2 µm). Injector and detector temperatures were set at 250 and 260ºC, respectively. The oven was programmed at an initial temperature of 140ºC and an initial time of 5 min. Thereafter, the temperature was increased up to 240°C at a rate of 3°C/min^{-1}. Total run time was 41.33 min. Helium was used as the carrier gas (1 ml min^{-1}). Identification of fatty acids was carried out by comparing sample FAME peak relative retention times. The results were expressed as flame ionisation detector (FID) response area in relative percentages. Each reported result is given as the mean of three GC determinations presented as mean ± standard deviation (SD).

RESULTS

Twenty one fatty acids were identified in the six *Centaurea* species and subspecies. The fatty acid composition of the plant is shown in Table 1.

The major fatty acids with 16 and 18 carbons were determined to be palmitic, oleic and linoleic acids. Saturated fatty acids (SFAs) of *Centaurea* of all the species/ ranged from 24.61 - 50.92% of the total fatty acids, while monounsaturated fatty acids (MUFAs) were in the range 3.40 - 37.96%, polyunsaturated fatty acids (PUFAs) were in the range 12.21 - 20.57%. Except for *C. saligna* and *C. urvillei* subsp. *hayekiana*, palmitic acid was identified as the major component of the *Centaurea* species. Oleic acid, with 26.92 and 50.92 %, was the main constituent of *C. urvillei* subps. *urvillei* and *C. agrregata* subsp. *aggregata*, respectively.

DISCUSSION

Saturated fatty acids (SFAs) were detected in *C. aggregata* subsp. *aggregata* with 50.92% while *C. urvillei* subsp. *hayekiana* showed the lowest saturated fatty acid content with 24.61%. Yildirim *et al* previously reported palmitic acid as the main fatty acid component of some *Centaurea* species [17] thus showing good aggrement with the results of the present study. Palmitic acid was the main SFA and ranged between 16.61 and 37.75%. In agreement with the present results, palmitic acid has previously been shown to demonstrate the highest proportion in the SFAs of some *Centaurea* plants [15,17-20].

PUFAs ranged from 12.21 to 20.57% while linoleic acid content ranged from 0.41 to 17.40%. The fatty acid composition of some *Centaurea* oils which was previously determined, indicate that linoleic acid content was 11.69 and 55.27% in *C. rigida* and *C. kotschyi* var. *kotschyi*, respectively [15,18].

Oleic acid was the most dominant MUFA in all *Centaurea* species except for *C. depressa*. The level of oleic acid reached 25.12% in *C. urvillei* subsp. *hayekiana*. In a previous study, oleic acid was reported to be the main constituent of

Table 1: Fatty acid composition (%) of *Centaurea* species (n = 3)

Fatty acid	*C. behen*	*C. saligna*	*C. depressa*	*C. urvillei subsp. urvillei*	*C. urvillei* subsp. *hayekiana*	*C.aggregata*
C 4:0	0.22[a]	-	0.14	0.56	-	0.28
C 6:0	0.09	0.22	0.08	0.28	-	0.09
C 8:0	0.17	0.54	0.13	0.21	0.12	0.26
C 12:0	1.06	0.40	0.08	1.07	0.86	0.31
C 13:0	-	-	0.15	-	-	-
C 14:0	1.05	0.49	1.05	0.63	0.48	1.01
C 15:0	0.55	-	0.28	0.36	0.23	0.84
C 16:0	25.86	16.61	22.18	17.56	16.62	37.75
C 17:0	0.67	0.48	0.25	0.45	0.33	0.81
C 18:0	4.27	6.05	2.87	4.37	5.40	7.48
C 21:0	0.35	0.38	0.18	0.17	0.20	0.56
C 22:0	2.47	1.62	0.84	0.62	-	0.48
C 23:0	0.77	0.61	0.44	0.64	0.37	1.05
C 24:0	1.12	-	-	-	-	-
∑**SFA**[b]	38.65	26.91	28.67	26.92	24.61	50.92
C 18:1 ω9	9.72	19.53	7.96	10.71	25.12	3.40
C 20:1 ω9	0.84	0.53	13.81	0.33	0.37	-
C 24:1 ω9	0.14	-	-	-	-	-
∑**MUFA**[b]	10.70	20.06	21.77	10.71	25.49	3.40
C 18:2 ω6	8.23	11.52	13.6	12.68	17.40	0.41
C 18:3 ω6	3.08	2.89	2.24	1.84	1.05	3.78
C 20:3 ω3	3.62	4.28	3.51	1.78	0.96	5.37
C 20:5 ω3	1.47	1.88	1.17	1.61	0.83	2.65
∑**PUFA**[b]	16.40	20.57	20.52	17.91	20.24	12.21

[a]n = 3; [b]SFA = saturated fatty acids, MUFA = monounsaturated fatty acids, and PUFA = polyunsaturated fatty acids

C. ptosimopappoides and *C. patuala* oil [18,19]. Recently, oleic acid was claimed to be the major MUFA in the oil of *C. kotschyi* var. *kotschyi, C. pterocaula, C. solstitialis* subsp. *solstitialis*, *C. triumfettii, C. urvillei* subsp. *urvillei* and *C. virgata* collected from Konya, Turkey [15]. Similar to the obtained results, oleic acid was also identified as the major MUFA and linoleic acid identified as the major PUFA in selected *Centaurea* species [8]. Linoleic acid has been detected in the fatty acids derived from some *Asteraceae* species [21-23]. Oleic and linoleic acid have the capability to lower blood cholesterol levels. Intake of these fatty acids are promoted by nutritionists and the health professionals [24]. Oleic acid, with the ability of reducing low-density lipoprotein (LDL) levels and possibly increasing high-density lipoprotein (HDL) levels, is known as a monounsaturated fatty acid in normal diet [25]. The lack of dietary essential fatty acids such as linoleic acid has been implicated in the aetiology of diseases including cardiovascular diseases and their progression [26]. Linoleic acid cannot be synthesized by the human body and it is known to be essential for human body [27]. Linolenic acid with protective effect against heart disease has been shown to play a role in the development of the brain and retina [28].

CONCLUSION

PUFAs are beneficial to health and the oils obtained from *Centaurea* species with high content of PUFAs should be beneficial to human health. Furthermore, this oil may be useful as additives in food and health supplements. The oil of *Centaurea* species is a good source of essential fatty acids.

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