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Essential Oil and Fatty Acid Composition of *Centaurea solstitialis* ssp. *solstitialis*

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Abstract: *Centaurea* is a widespread genus from Asteraceae family in Turkey. There are plenty of researches about fatty acid and essential oil profiles of *Centaurea* species. Essential oils were obtained using a Clevenger apparatus by hydrodistillation from aerial part of the plant. The essential oil composition of the plant was identified by GC-MS using FID detector. 31 compounds representing 91.5% were identified. Hexadecanoic acid (50.2%) and tetradecanoic acid(10.1%) were found to be the major compounds. For fatty acids, fatty acid methyl esters (FAMEs) were prepared. The fatty acid compositions were analyzed by GC. Saturated fatty acids (SFAs) were totally 25.05%, monounsaturated fatty acids (MUFAs) were 19.60% and polyunsaturated fatty acids were 19.86%. The major compounds were found as oleic acid (18.54%), linoleic acid (10.07%), palmitic acid (8.28%), stearic acid (6.82%) and γ- linoleic acid (6.75%).

Keywords: *Centaurea*, essential oil, fatty acid

1. INTRODUCTION

Asteraceae family which is included in Cynarae ordo comprises 4 sub-ordo; Carduinea, Carlineae, Centaureinae and Echinipsideae. *Centaurea* is included in Centaureinae. Asteraceae family has 130 genus in Turkey. *Centaurea* is a widespread genus including 180 species [1, 2]. *Centaurea* genus is widely used in folk medicine as sedative, antipyretic and against allergy in Turkey. *Centaurea solstitialis* ssp. *solstitialis* is an also widespread species from this genus. According to the etnobotanic researches, *C. solstitalis* ssp. *solstitialis* is mostly used for urinary diseases [3]. When we examine the the general content of the species it is well known that sesquiterpene lactones, flavonoids and polyacetylenes are major groups of seconder metabolites [4-6].

Fatty acids have many important biological functions such as presenting in biological membran structure and being an energy source. PUFAs and MUFAs are useful for decreasing LDL [7]. Essential oils have also different biological activities such as antimicrobial and

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antioxidant. There are lots of essential oil and fatty acid researches about different *Centaurea* species [8].

In this study we present the volatile oil profile and fatty acid content of *C. solstitialis* ssp. *solstitalis*. To the best of our knowledge, this is the first report for determining essential oil and fatty acid profile of *Centaurea solstitialis* ssp. *solstitialis* from Elazığ, Turkey.

2. MATERIAL and METHODS

2.1. Plant Material

C. solstitalis ssp. *solstitialis* was collected from Elazığ, Turkey in 2011. The plant was identified by one of the authors (B. Kivcak) from Ege University. Voucher specimen was deposited by number 1468 in the Herbarium of Faculty of Pharmacy, Department of Pharmacognosy, Ege University, Izmir, Turkey. The dried and powdered aerial parts of the plant material (40 g) have been extracted by petroleum ether (400 ml) for 6 h at 60ºC by Soxhlet extractor. The solvent was evaporated by a rotary evaporator. The obtained oil was esterified to determine the fatty acid composition. Additionally the air-dried aerial parts of the plant was subjected to hydrodistillation for 3 h using a Clevenger-type apparatus to obtain essential oil.

2.2. Fatty acid methyl esters (FAMEs) preparation

The fatty acids were esterified into methyl esters by saponification with methanol (50%) containing 5% sodium hydroxide at 100 ºC for 10 min and transesterified with 14% (v/v) boron trifluoride (BF_3) in methanol 100 ºC for 5 min (A).

2.3. GC Conditions

Fatty acid methyl esters (FAMEs) were analyzed on a HP (Hewlett Packard) Agilent 6890 N model gas chromatograph (GC), equipped with a flame ionization detector (FID) and fitted to a Supelco SP-2380 Fased Silica capillary column (60 m, 0.25 mm i.d. and 0.2 µm). Injector and detector temperatures were set at 250ºC 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}. The 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 peaks from samples with standarts (26). The results were expressed as FID response area in the relative percentages. Each reported result is given as the average value of three GC analyses. The results are offered as means ±S.D.

2.4. Gas Chromatography-mass spectrometry (GC-MS) Conditions

Agilent gas chromatograph model 6890 equipped with an Innowax FSC column (60 m x 0,25 mm x 0,25µm). Instrument conditions were programmed from 60ºC (10 min) to 220ºC (5ºC/min), stayed 10 min at 220ºC and to 240ºC for 1 min. Split ratio was 40:1; injector and detector temperatures were 250 and 280ºC, respectively. The MS conditions were programmed as ionization potential at 70 eV, between 35-450 mass range. In order to identificate the components by comparison, their relative retention times and their relative retention indices (RRI) were used by analyzing Wiley GC/MS Library, Adams Library, MassFinder Library and in Baser Library. Retention indices were determined by using standard alkanes (C_9-C_{30}) and also by comparison of literature data.

3. RESULTS AND DISCUSSION

The results of fatty acid analyses are shown in Table 1. Saturated fatty acids (SFAs) were totally 25.05%, monounsaturated fatty acids (MUFAs) were 19.60% and polyunsaturated fatty acids were 19.86%. The major compounds were found as C 18:1 ω9 (oleic acid) (18.54%), C 18:2

ω6 (linoleic acid) (10.07%), C 16:0 (palmitic acid) (8.28%), C 18:0 (stearic acid) (6.82%) and C 18:3 ω6 (γ- linoleic acid) (6.75%).

Table 1. Fatty Acid Profile of *C. solstitialis* ssp. *Solstitialis*

Fatty Acids	*Centaurea solstitialis* ssp. *solstitialis*
C 4:0 (Butyric acid)	-
C 6:0 (Caproic acid)	-
C 8:0 (Caprilic acid)	1.76
C 12:0 (Lauric acid)	2.87
C 13:0 (Tridecyclic acid)	-
C 14:0 (Miristic acid)	2.45
C 15:0 (Pentadecanoic acid)	1.06
C 16:0 (Palmitic acid)	8.28
C 17:0(Heptadecanoic acid)	-
C 18:0 (Stearic acid)	6.82
C 21:0(Heneicanoic acid)	1.08
C 22:0 (Behenic acid)	-
C 23:0 (Tricosanoic acid)	0.56
C 24:0 (Lignoseric acid)	0.17
∑SFA[b]	25.05
C 18:1 ω9 (Oleic acid)	18.54
C 20:1 ω9 (Gondoic acid)	-
C 24:1 ω9 (Nervonic acid)	1.06
∑MUFA[b]	19.60
C 18:2 ω6 (Linoleic acid)	10.07
C 18:3 ω6 (γ-linolenic acid)	6.75
C20:3ω3(Eicosotrienoic acid)	3.04
∑PUFA[b]	19.86

[a]n: 3; SFA: saturated fatty acids, MUFA: monounsaturated fatty acids, PUFA: polyunsaturated fatty acids

The hydrodistillation of the aerial part of *C. solstitialis* ssp *solstitialis* gives essential oil of yellow colour. The identified components of essential oils and percentages are shown in Table 2. 31 compounds representing 91.5% were identified. Hexadecanoic acid (50.2%) and tetradecanoic acid(10.1%) were found to be the major compounds.

Table 2. Identified Essential Oil Components from *C. solstitalis* ssp. *solstitialis*

RRI	COMPOUND	PERCENTAGE (%)
1400	Nonanal	0.3
1705	Zizanene	0.3
1740	α-Muurolene	0.4
1827	(*E*,*E*)-2,4-Decadienal	0.7
1830	Tridecanal	
1838	(*E*)-β-Damascenone	0.3
1868	(*E*)-Geranyl acetone	0.3
1870	Hexanoic acid	0.1
1945	1,5-Epoxy-salvial(4)14-ene	0.6
1958	(*E*)-β-Ionone	0.6
2008	Caryophyllene oxide	1.1
2037	Salvial-4(14)-en-1-one	0.6
2041	Pentadecanal	0.3
2080	Junenol (=Eudesm-4(15)-en-6-ol)	0.5
2084	Octanoic acid	0.6
2098	Globulol	0.5
2130	Salviadienol	0.3
2131	Hexahydrofarnesyl acetone	1.0
2144	Spathulenol	4.4
2209	T-Muurolol	0.8
2255	α-Cadinol	1.1
2278	Torilenol	0.9
2300	Tricosane	1.1
2369	Eudesma-4(15),7-dien-4β-ol	1.0
2500	Pentacosane	0.8
2503	Dodecanoic acid	4.4
2622	Phytol	2.7
2670	Tetradecanoic acid	10.1
2700	Heptacosane	2.5
2822	Pentadecanoic acid	1.3
2900	Nonacosane	0.7
2931	Hexadecanoic acid	51.2
		91.5

In previous studies for fatty acid profile; C 18:2 ω6 (linoleic acid) and α-linoleic acid seemed to be the major compoud and C 18:1 ω9 (oleic acid) and C 16:0 (palmitic acid) are also predominantly major compounds. Our results are compatible with literature about fatty acid profile of *Centaurea* species. Oleic acid; monounsaturated fatty acid (MUFA) is the major compound of our research and this result can show that *C. solstitialis* ssp. *solstitialis* can be beneficial for decreasing LDL [7, 9].

According to the literature an essential oil research about *C. solstitialis* from Iran showed different profile than our research about *C. solstitialis* ssp. *solstitialis.* In that research hexadecanoic acid was also found to be a major (30.8 %) compound with a different amount and caryophyllene oxide (25.2 %) was also a major compound [10]. This difference may be because of the region or the variation of subspecies. Additionally other researches of essential

oil composition of *Centaurea* species showed; caryophyllene oxide, spathulenol, tetracosane, arachidic acid, hexadecanoic acid, isononane and tetradecanoic acid were mostly found major compounds. Consequently our results are compatible with other *Centaurea* species [11, 12].

Conflict of Interests

Authors declare that there is no conflict of interests.

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