

Volatile compounds of essential oil *Centaurea behen* L. grown in Iran

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ABSTRACT

The essential oils from Compositae specie of Iran: *Centaurea behen* L. obtained by hydrodistillation was analyzed by GC and GC/MS. β -Caryooyllane (24.5%), β -selinene (13.9%) and valencene (11.7%) were the main components among the sixteen constituents characterized in the oil of *Centaurea behen* representing 93.7% of the total components detected.

Keywords: *Centaurea behen*; compositae; essential oil; composition; β -caryooyllane.

INTRODUCTION

Seventy-four species of the genus *Centaurea* are found in Iran, among which thirty-eight are endemic [1,2]. Previous chemical investigation on *Centaurea* species have shown the presence of flavonoids [3] sesquiterpene lactones specially guaianolides [4-6] and germacranolide types sesquiterpene lactones [3]. Sesquiterpene lactones have been reported to have multiple biological effects including cytotoxic antibacterial, anti-inflammatory, hypotensive and many others. Volatile constituents studies are available in the literature on *Centaurea species*: *C. thessala* subsp. drakiensis, *C. zuccariniana*, *C. spruneri*, *C. raphanina* subsp. mixta, and *C. pelia* [10, 11], *C. calcitrapa* and *C. solstitialis* [12-14], *C. calcitrapa*, *C. gloriosa*, and *C. moschata* [15-17], *C. pseudoscabiosa* subsp. pseudoscabiosa, and *C. hadimensis* [18], and *C. kotschy* var. kotschy and *C. kotschy* var. decumbens [19]. our study deals with the analysis of the volatile oil isolated from *Centaurea behen* L. growing wild in Iran.

MATERIALS AND METHODS

Plant materials: The aerial parts of *Centaurea behen* L. were collected in June 2009 from Givi, Khalkhal road (Ardabil province) in the northwest of Iran at an altitude of 1400 m. A voucher specimen (No: 1563) has been deposited at the Herbarium of the Agriculture Research Centre (A.R.C.) Ardabil, Iran.

Extraction of the oils: The air-dried aerial parts of *Centaurea behen* was separately subjected to hydrodistillation using a Clevenger-type apparatus for 4h. After decanting and drying of the oils over anhydrous sodium sulfate, the corresponding oils were isolated in yield of 0.16% (w/w).

Analysis : GC analysis was performed on a Shimadzu 15A gas chromatography equipped with a split/ splittess injector (250° C) and a flame ionization detector (250° C). N₂ was used as carrier gas (1mL/min) and the capillary column used was DB-5 (50m×0.2mm, film thickness 0.32 μ m).

The column temperature was kept at 60°C for 3 min and then heated to 220°C with a 5°C/min rate and kept constant at 220°C for 5min.

GC/MS analysis was performed using a Hewlett-Packard 5973 with a HP-5MS column (30m×0.25mm, film thickness 0.25 μ m). The column temperature was kept at 60 °C for 3min and programmed to 220°C at a rate of 5° C /min, and kept constant at 220°C for 3min .The flow rate of Helium as carrier gas with (1mL/min). MS were taken at 70eV. Identification of the constituents of each oil was made by comparison of their mass spectra and retention indices (RI) with those given in the literature and those authentic samples [7]. Relative percentage amounts were calculated from peak area using a Shimadzu C-R4A chromatopac.

RESULTS

The essential oil, with yellow color, was obtained by hydrodistillation in a Clevenger-type apparatus from whole plant of *C. behen* with the yields of 0.16% (w/w) on dry weight. The essential oil of *C. behen* was analyzed by GC-MS with HP-5 column. The composition of the essential oils of *C. behen* was listed in Table I, in which the percentage and retention indices of components are given. As it is shown, about 93.7% (16 compounds) was identified. The oil of *Centaurea behen* consisted of five monoterpenes (7.8%), eleven sesquiterpene hydrocarbons (85.9%). Caryooyllane (24.5%), β -selinene (13.9%) and valencene (11.7%) were the major components in this oil, followed by δ -cadinene (8.7%), Epi- α -muurolene (7.6%), α -humulene (6.5%) and α -copane (4.0%).

Table 1. Chemical composition (%) of the essential oils of aerial part of *Centaurea behen* L.

Compound	RI ^b	%
α -pinene	939	3.0
myrcene	992	2.8
trans-cymene	1026	1.0
α -terpinene	1063	0.7
(E)- β -ocimene	1067	0.3
α -copane	1376	6.2
β -bourbonene	1384	0.2
aromadendrene	1397	0.5
β -caryooyllane	1418	24.5
α -humulene	1452	6.5
Epi- α -muurolene	1641	7.6
β -selinene	1660	13.9
δ -cadinene	1664	8.7
Valencene	1670	12.5
selina-3,7(11)-diene	1680	5.0
β -selinene	1705	0.3

DISCUSSION

Piperitone (35.2%) and elemol (14.1%) were the main components among the twenty-six constituents characterized in the oil of *Centaurea depressa* representing 90.5% of the total components detected [8]. The oil of *Centaurea depressa* consisted of four oxygenated monoterpenes (36.5%), Six sesquiterpene hydrocarbons (5.9%), ten oxygenated

sesquiterpenes (39.7%), five aliphatic hydrocarbons (4.4%) and one aliphatic acid (4.0%). Eighteen components were identified in the oil of *Centaurea solstitialis* representing 86.6% of the total oil with hexadecanoic acid (30.8%) and caryophyllene oxide (25.2%) as major constituents [9]. The oil of *C. solstitialis* consisted of eight monoterpenes (16.5%), nine sesquiterpenes (39.3%) and one aliphatic acid (30.8%). Hexadecanoic acid (plamitic acid) (30.8%) and caryophyllene oxide (25.2%) were the major compounds in this oil, followed by 1,8-cineole (9.6%) and β -caryophyllene (6.2%). Our results, comparing these results with our previous investigation on oils of the *Centaurea* genus, showed also dominated by sesquiterpenes. Piperitone (35.2%) and elemol (14.1%) were the main components among the twenty-six constituents characterized in the oil of *Centaurea depressa* representing 90.5% of the total components detected [8]. Mirza et al., (2003) reported that Iran collected in the Tehran province ((Bomehen) forms of *C. behen* contained twenty-one compounds and in this plant in other local in Iran were identified that constitute 91% of the oil. The main constituents of the essential oil were β -caryophyllene (40.3%), β -sesquiphellandrene (18.4%), and caryophene oxide (9.9%) (21). So, in research shown The structure of a guaianolide and lactones previously reported from this plant by Rustaiyan (4). Comparing samples of GC-MS spectra showed previous study reported only two major compound (β -caryophyllene and β -sesquiphellandrene), and in this study have less compounds with three major compounds (β -Caryooyllane, β -selinene and valencene). In this different results can be return to collected locals. So percentage monoterpenoids were more in previous study. That can be concluded that *C. behen* collected from Givi, Khalkhal road (Ardabil province) were mostly flowers in the Tehran province (Bomehen). The oil of *Centaurea depressa* consisted of four oxygenated monoterpenes (36.5%), Six sesquiterpene hydrocarbons (5.9%), ten oxygenated sesquiterpenes (39.7%), five aliphatic hydrocarbons (4.4%) and one aliphatic acid (4.0%). Eighteen components were identified in the oil of *Centaurea solstitialis* representing

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investigation on oils of the *Centaurea* genus, showed also dominated by sesquiterpenes. β -Eudesmol (12.4%), caryophyllene oxide (10.0%), were the main constituents of the essential oil of *C. sessilis*. The main components of the essential oil of *C. armena* were beudesmol (19.3%) and calarene (10.3%), 6,10,14-trimethyl- 2-pentadecanone (5.7%), and β -caryophyllene (5.4%) [20]. Our report shown *Centaurea* genus have almost simillar compounds.

REFERENCES

1. Rechinger KH. *Centaurea*, In : Flora Iranica, Compositae No139. Edits Rechinger KH, and Hedge IC, Akademische Druck and Verlagsanstalt, Graz, Austria. 1989;327:226.
2. Mozaffarian V. A Dictionary of Iranian plant Names. Farhang Moaser publishers, Tehran, Iran 1996.
3. Rustaiyan A, Niknejad A, Aynehchi Y. Chemical constituents of *Centaurea bruguieriana*. *Planta Med.*,1982;44:185-6.
4. Rustaiyan A, Niknejad A, Zdero C, Bohlmann F, Guaianolide from *Centaurea behen*. *Phytochem.* 1981;20:2427-9.
5. Rustaiyan A, Ardebili S, New guaianolides from *Centaurea kandavanensis*. *Planta Med.*, 1984;46:363-4.
6. Rustaiyan A, Nazarians L, Bohlmann F, Guaianolides from *Acroptilon repens* (*Centaurea picris*). *Phytochem.* 1981;20:1152-3.
7. Adams RP, Identification of Essential Oil Components by Gas Chromatography/Mass Spectroscopy, Allured Publishing.Corp., Carol Stream,IL 1995.
8. Esmaili A, Tadyaon F, Rustaiyan A, Amiri H. Volatile constituents of *Centaurea depressa* M.B. and *Carduus pycnocephalus* L. two compositae herbs growing wild in Iran, *J. of Essent. Oil Res.* 2005;17:539-41.
9. Esmaili A, Rustaiyan A, Moazami N, Masoudi S, Amiri H, Composition of the essential oils of *Xanthium strumarium* L. and *Centaurea solstitialis* L. from Iran, *J. of Essent. Oil Res.* 2006;18:427-9.
10. Lazari DM, Skaltsa HD, Conrstantinidis T. Volatile constituents of *Centaurea raphanina* Sm. Subsp. mixta (DC.) Runemark and *C. spruneri* Boiss. and Heldr. (Asteracea), growing wild in Greece. *Flav. Fragr. J.* 1999;14:415-8.
11. Lazari DM, Skaltsa HD, Conrstantinidis T. Volatile constituents of *Centaurea pelia* DC., *C. thessala* Hausskn. subsp. drakiensis (Freyn & Sint) Georg 2000.
12. Buttery RG, Maddox DM, Light DM, Ling LC. Volatile components of yellow starthistle. *J. Agric. Food Chem.* 1986;34:786-8.
13. Binder RG, Turner CE, Flath RA. Comporasion of yellow starthistle volatiles from different plant parts. *J. Agric. Food Chem.* 1990a;38:764-7.
14. Binder RG, Turner CE, Flath RA. Volatile components of purple starthistle. *J. Agric. Food Chem.* 1990b;38:1053-1055.
15. Karawya MS, Hilal SH, Hifnawy MS, El-Hawary SS. Phytochemical study of *Centaurea calcitrapa* L. growing in Egypt. *Egypt J. Pharm. Sci.* 1975;16:429-44.
16. Kustrak D, Radic J. Pharmacobotanical studies of *Centaurea gloriosa* var. multiflora Radic. *Pharm. Acta Helv.* 1985;60:260-8.
17. Saleh MM, Awad N, El-Kholy SA. Gas-chromatographic analysis of the volatile oil of *Centaurea moscata* L. *Egypt J. Pharm. Sci.* 1981;22:1-4.
18. Flamini G, Ertugrul K, Cioni PL, Morelli I, Dural H, Bagcı Y. Volatile constituents of two endemic *Centaurea* species from Turkey: *C. pseudoscabiosa* subsp. pseudoscabiosa and *C. hadimensis*. *Biochem. System. Ecol.* 2002;30:953-9.
19. Ertugrul K, Dural H, Tugay O, Flamini G, Cioni PL, Morelli I. Essential oils from flowers of *Centaurea kotschyi* var. kotschyi and *C. kotschyi* var. decumbens from Turkey. *Flav. Fragr. J.* 2003;18:95-7.

20. Yayli N, Yasar A, Gulec C, Ustaa A, Kolayli S, Coskuncelebi K, Karaoglu S. Composition and antimicrobial activity of essential oils from *Centaurea sessilis* and *Centaurea armena* Phytochem. 2005;66:1741-5.
21. Mirza M, Navaei N, Dini M. Chemical composition of the essential oil *Centaurea behen* L. 2003; 19(3):227-232.