IJPSR (2014), Vol. 5, Issue 12 (Research Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 12 May, 2014; received in revised form, 08 July, 2014; accepted, 15 August, 2014; published 01 December, 2014

CHEMICAL COMPOSITION OF ESSENTIAL OIL FROM LEAVES AND FLOWERS OF *INULA VISCOSA* (L.) IN AL-QADMOUS REGION, SYRIA

M. Nasser [1*], S. Housheh [2], A. Kourini [3] and N. Maala [1]

Department of Basic Sciences [1], Department of Quality Control & Pharmaceutical Chemistry [2], Department of Analytical and food Sciences [3], Faculty of Pharmacy, Al-Andalus University for Medical Science, Al-Qadmous, Syrian Arab Republic.

Keywords:

Clevenger-type apparatus; E-Foreseen Epoxide; Essential oil; *Inula Viscosa L.*; GC/MS; Nerolidol B.

Correspondence to Author:
Muhammad Nasser

Faculty of pharmacy,
Al-Andalus University for Medical Science. Department of Basic Sciences, Al-Qadmous, Syrian Arab Republic.
E-mail: ws.sarah2005@gmail.com

ABSTRACT: Leaves and flowers of *Inula viscosa (L.)* were collected from fields in Al-Qadmous, Syria. Essential oil was isolated by classical method of hydro distillation using the Clevenger-type apparatus. Its chemical composition was analyzed by GC/MS. The analysis led to the identification of48 and 43 components in flowers and leaves, respectively. Essential oils were characterized by a high content of oxygenated sesquiterpenes (53.85% and 54.29%, respectively), with E-Foreseen Epoxide (22.41 % and 16.55%, respectively) and Nerolidol B (15.70% and 13.64%, respectively), as the main components.

INTRODUCTION: In the quest for new therapeutics, plants were and still are considered as one of the main sources of biologically active materials.[1] *Inula viscosa* (L.) Aiton (*Compositae*) (common local name: Taioon) is a perennial plant distributed in different regions of the Mediterranean Basin.[2] In traditional medicine, *Inula viscose* has many uses, including anti-inflammatory [3, 4], anthelmintic, antipyretic, antiseptic, antitumoral [5, 6] and antiphlogistic activity [7, 8], in addition to treating gastro duodenal and lung disorders [9, 10].

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.5(12).5177-82

Article can be accessed online on: www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.5(12).5177-82

Crude extracts prepared from different parts of *Inula viscose* exhibit antioxidant[11], antiulcerogenic[12] and anthelmintic[13] properties and prevent zygote implantation.[14]

Aqueous extracts of *Inula viscose* (L.) are shown to exhibit antifungal activity in vitro[15-17], and organic solvent extracts are shown to be antibacterial.[18] Cohen et al. provides evidence for the antifungal activity of extracts made with organic solvents, including methanol, ethanol, ethyl acetate, acetone, chloroform, and n-hexane.[19]

This plant is distributed in several areas of Syria and contains some pharmacologically active compounds, including flavonoids and terpenoids.[4] The volatile constituents of the roots and the aerial parts of this plant have been previously reported from different countries.[20-25] The main constituents of the *Inula viscosa*'s essential oil vary depending on regions; these constituents are known for some

countries; for example the essential oil from France[21] has: 21.1% fokienol, 8.6% (E)-nerolidol and 6.2% eudesm-6-en-4α-ol; in Italy[22], 16.8% globulol, 12.0% valerianol and 8.0% caryophyllene oxide; in Turkey[23], 25.2% borneol, 19.5% bornyl acetate and 22.5% isobornyl acetate and in Spain[24], 38.8 % fokienol and 7.1 % (E)-nerolidol. Fourteen known and four new compounds are isolated from Jordanian *Inula viscosa.*[25]

Taking into account the use of *Inula viscose* in traditional medicine, its wide distribution, and the difference in chemical composition of essential oil depending on regions, the present study is undertaken to report the GC/MS analyses of the oil extracted from the aerial parts (Leaves and flowers) of the Syrian species *Inula viscosa (L.)* growing in Al-Qadmous, which has not been reported previously.

MATERIALS AND METHODS:

Plant material

The aerial parts (Leaves and flowers) of *Inula viscosa (L.)* were collected in October2013 from populations growing wild in Al-Qadmous (Syria). The plant was identified by Prof. Zouher Alshater, from the Faculty of Agriculture at Tishreen University (Syria).

Isolation of the essential oil

The classical method of hydro distillation using the Clevenger-type apparatus for 4h was used for the isolation of the essential oil from the aerial parts of *Inula viscosa (L.),* according to the British Pharmacopeia. The essential oil was collected and stored at 4°C until its analysis by gas chromatography/mass spectrometry (GC/MS).

The results were the mean of the three wild-growing populations collected at each time from the same sites. Essential oil concentration was expressed in milliliters/100 g of dry weight of plant material. The moisture content of the material analyzed was determined after oven-drying at 105 °C for 24 h.

GC-MS analysis

Quantitative analysis was carried out using a Hewlett Packard HP-8590 gas chromatograph equipped with a split-splitless injector (split ratio, 1:8) and an FID detector. An OPTIMA-5 fused silica capillary column (30 m x 0.25 mm, 0.25µm film thickness) was used.

The oil was analyzed under linear temperature program applied at 3°C/min to280°Cwith 5 min hold. Temperatures of the injector and detector (FID) were maintained at 250°C and 300°C, respectively. Helium was the carrier gas (flow rate 1 mL/min).

The actual temperature in MS source reached approximately 230ºC. The ionization voltage was 70 eV, split ratio (60:1), scan mode 40-550 u.m.a. A hydrocarbon mixture of n- alkanes (C8-C20) was analyzed separately by GC/MS under same chromatographic conditions using the same HP-5 column.

Identification of components

Essential oil components were identified by comparison of their mass spectral fragmentation patterns with those reported in the literatures and with authentic compounds.[26]

RESULTS AND DISCUSSION:

Steam distillation of flowers and leaves of *Inula viscosa* yielded light yellow-colored essential oil 0.10% and 0.09%, respectively. The obtained oil was analyzed by GC/MS, the chromatograms of flowers and leaves were shown in **Figure 1** and **Figure 2**, respectively.

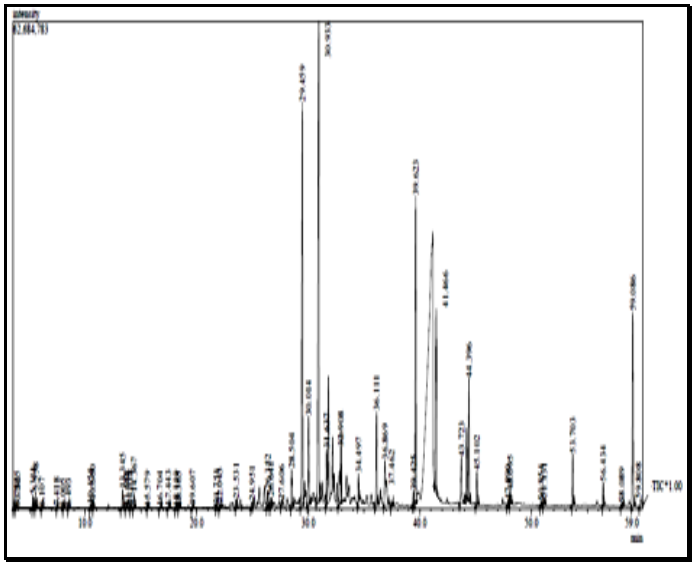

FIGURE 1: GC/MS CHROMATOGRAM OF THE ESSENTIAL OIL EXTRACTED FROM THE FLOWERS OF *INULA VISCOSE* (*L.*)

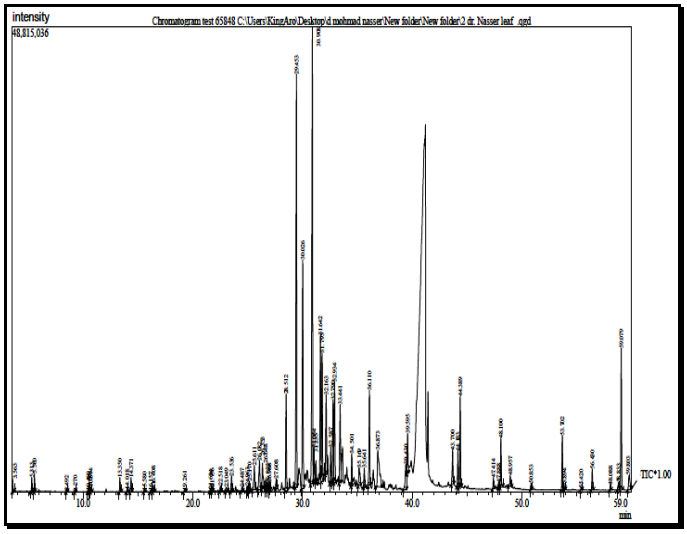

FIGURE 2: GC/MS CHROMATOGRAM OF THE ESSENTIAL OIL EXTRACTED FROM THE LEAVES OF *INULA VISCOSE* (*L.*)

Forty eight and forty three components, representing 83.01% and 71.13% of the peak area of the oil extracted from flowers and leaves respectively, were identified and listed in **Table 1** and **Table 2** in order of elution from a HP-8590 capillary column.

TABLE 1: CHEMICAL COMPOSITION (%) *INULA VISCOSE* (*L.*) OIL EXTRACTED FROM FLOWERS

Peak	R_t	Name	Area%
1.	3.565	2-Hexenal	0.14
2.	3.782	1-Hexanol	0.04
3.	5.311	Hydroperoxide, 1-Ethylbutyl	0.25
4.	5.558	Hydroperoxide, 1-Methylpentyl	0.32
5.	6.107	Hexanoic Acid	0.03
6.	7.418	2,4 Heptadienal	0.03
7.	8.005	Eucalyptol	0.02
8.	8.493	Phenyl Acetaldehyde	0.02
9.	10.454	Linalool L	0.09
10.	10.660	6-Methyl-3,5-Heptadien-2-One	0.19
11.	13.345	P-Mentha-1,5-Dien-8-Ol	0.62
12.	13.688	4-Terpineol	0.05
13.	14.018	P-Cymen-8-Ol	0.06
14.	14.367	P-Mentha-1,5-Dien-8-Ol	0.58
15.	15.579	Isoborneol	0.03
16.	16.704	Geraniol	0.04
17.	17.443	Nonanoic Acid	0.09
18.	18.140	Dihydroedulan II	0.04
19.	18.365	Dihydroedulan I	0.04
20.	19.607	2,4-Decadienal	0.07
21.	21.751	Alpha. Copaene	0.11
22.	22.043	Damascenone	0.15
23.	23.531	Beta. Caryophyllene	0.32
24.	24.951	Neryl Acetone	0.21
25.	26.352	Beta. Selinene	0.70
26.	26.641	Alpha. Selinene	0.41
27.	27.606	Delta. Cadinene	0.17
28.	28.504	Alpha. Copaene-11-Ol	1.44
29.	29.459	Nerolidol B	15.70
30.	30.014	Caryophyllene Oxide	3.80
31.	30.933	E- Farnesene Epoxide	22.41
32.	31.637	Selina-6-En-4-Ol	2.19
33.	32.908	Beta. Eudesmol	2.54
34.	36.111	Cedren-13-Ol, 8-	3.45
35.	37.462	1-Pentadecanol	0.17
36.	39.425	9-Hexadecenoic Acid	0.58
37.	39.623	Octadecanoic Acid	11.29
38.	43.723	Palmitic Acid	2.24
39.	45.102	1-Hexadecanol, Acetate	1.11
40.	47.890	Eicosane	0.16
41.	48.095	Phytol	0.48
42.	50.854	Heneicosane	0.18
43.	51.131	Octadecyl Acetate	0.22
44.	53.703	Docosane	1.82
45.	56.434	Tricosane	0.78
46.	58.089	Tetracosane	0.10
47.	59.086	Pentacosane	7.06
48.	59.808	Hexacosane	0.47
		Total Area%	83.01

TABLE 2: CHEMICAL COMPOSITION (%) *INULA VISCOSA* (*L.*) OIL EXTRACTED FROM LEAVES.

Peak	R_t	Name	Area%
1.	3.563	2-hexenal	0.19
2.	5.313	Hydroperoxide, 1-ethylbutyl	0.24
3.	5.560	Hydroperoxide, 1-	0.32
4.	8.492	Phenylacetaldehyd	0.02
5.	9.270	Acetophenone	0.01
6.	10.460	Linalool l	0.03
7.	10.601	Ho-trienol	0.03
8.	14.018	P-cymen-8-ol	0.08
9.	14.371	P-Mentha-1(7),2-dien-8-ol	0.45
10.	15.580	Isoborneol	0.03
11.	16.157	Pulegone	0.03
12.	16.408	Carvone	0.18
13.	21.624	Decanoic acid	0.09
14.	21.756	Alpha. copaene	0.14
15.	22.518	(+)-3-Carene, 10-	0.16

16.	23.536	Beta. caryophyllene	0.51
17.	24.487	Aristolen	0.14
18.	25.170	Alloaromadendrene	0.30
19.	25.611	Cyclohexene, 2e,4e-	1.03
20.	26.082	Acetic acid, 4a-methyldecahydronaphthalen	1.29
21.	26.353	(+)-Beta. selinene	1.10
22.	26.648	Alpha. selinene	0.36
23.	26.822	Alpha. muurolene	0.18
24.	27.608	Delta. cadinene	0.28
25.	28.512	Alpha. copaene-11-ol	3.03
26.	29.453	Nerolidol b (cis or trans)	13.64
27.	30.026	Caryophyllene oxide	7.83
28.	30.908	Farnesene epoxide, E-	16.55
29.	31.642	Selina-6-en-4-ol	4.46
30.	32.790	Beta. eudesmol	2.60
31.	36.110	Cedren-13-ol, 8-	3.10
32.	39.430	9-Hexadecenoic acid	1.34
33.	43.700	Palmitic acid	1.22
34.	47.888	Eicosane	0.14
35.	48.100	Phytol	1.49
36.	48.957	Octadeca-9,12,15-trien-1-ol	0.41
37.	50.853	Heneicosane	0.19
38.	53.702	Docosane	1.66
39.	56.430	Tricosane	0.66
40.	58.088	Tetracosane	0.15
41.	58.833	1-eicosanol	0.26
42.	59.079	Pentacosane	4.36
43.	59.803	Hexacosane	0.85
		Total area%	71.13

As noticed in **Table 3**, the oil components of flowers can be classified into 8 different groups depending on their chemical composition, whereas the oil extracted from leaves contained one more group of components (Sesquiterpens).

The flowers and leaves of *Inula viscosa* essential oils were characterized by a high content of oxygenated sesquiterpenes (53.85% and 54.29%, respectively), with E-Foreseen Epoxide (22.41 % and 16.55%, respectively) and Nerolidol B (15.70% and 13.64%, respectively), as the main components. Carboxylic acids and esters represented about 28.34% from the oil extracted from flowers, whereas they were only 4.35% of the composition of leaves' oil. Hydrocarbons were present at much smaller amounts in oils, 10.25% and 8.01% respectively.

TABLE 3: THE MAIN CHEMICAL GROUPS IN THE ESSENTIAL OIL OF *INULA VISCOSA* (*L.*) EXTRACTED FROM FLOWERS AND LEAVES.

Chemical group	Area % Flowers	Area % Leaves
Hydrocarbons	10.57	8.01
Oxygenated Monoterpens	1.62	0.83
Oxygenated Sesquiterpens	53.85	54.28
Alcohols	0.04	0.26
Aldehydes & Ketones	0.38	0.22
Carboxylic Acids & Esters	28.34	4.35
Oxygenated Diterpens	0.48	1.49
Sesquiterpens	-	1.13
Others	0.57	0.56

Similar studies were carried out on the same plant in Jordan, France, Italy, Turkey and Spain, the major compounds of the essential oil of *Inula viscosa* (*L.*) as well as from Syrian plant are shown in (**Table 4**).

TABLE 4: MAJOR COMPONENTS OF ESSENTIAL OIL OF *INULA VISCOSE* (*L.*) OBTAINED FROM DIFFERENT LOCATIONS.

Major components	Area % Syria	Area % Jordan[25]	Area % France[21]	Area % Italy[22]	Area % Turkey[23]	Area % Spain[24]
Farnesene Epoxide, E-	22.41	-	-	-	-	-
Nerolidol B	15.70	19.75	8.6	1.9	1.5	7.1
Octadecanoic Acid	11.29	-	-	-	-	-
Caryophyllene Oxide	3.80	2.57	2.5	8.0	1.5	0.4
Beta. Eudesmol	2.54	5.64	6.2	-	0.8	-
Cedren-13-Ol, 8-	3.45	2.0	-	-	-	-
Palmitic Acid	2.24	-	-	-	-	-
Selina-6-En-4-Ol	2.19	2.18	1.6	1.8	-	-
Docosane	1.82	-	-	-	-	-
Alpha. Copaene-11-Ol	1.44	1.15	0.2	-	0.1	0.2
1-Hexadecanol, Acetate	1.11	-	-	-	-	-
Tricosane	0.78	-	-	-	-	-
Beta. Selinene	0.70	-	-	-	-	-
P-Mentha-1,5-Dien-8-Ol	0.58	1.60	0.9	trace	-	-
Phytol	0.48	-	-	-	-	-
Hexacosane	0.47	-	-	-	-	-

The composition of *Inula viscosa* (L.) essential oil from Al-Qadmous showed some similarities with the one from Jordan[25], particularly concerning the content of nerolidol B. Conversely, the compositions of the French[21] and Spanish[24] oil, exhibiting allylic tertiary alcohol (fokienol) as main component, that of Turkish oil, exhibiting borneol as main component, and that of Italian[22] oil, dominated by globulol, differed drastically from that of our sample.

CONCLUSIONS: In conclusion, the major constituent of essential oils of *Inula viscosa* from Al-Qadmous region is oxygenated sesquiterpenes (E-Foreseen Epoxide and Nerolidol B). This contrasts with the composition reported for *I. viscosa* oil from other countries; which may be explained by the influence of the soil nature and of the environment.

ACKNOWLEDGMENTS: The authors would like to thank Prof. Zouher Alshater, from Faculty of Agriculture at the Tishreen University (Syria) for identification of the plant. They also would like to thank Dr. Wissam Zam, from Faculty of Pharmacy at Al-Andalus University (Syria) for her scientific assistance.

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How to cite this article:
Nasser M, Housheh S, Kourini A and Maala N: Chemical Composition of Essential Oil from Leaves and Flowers of *Inula Viscosa* (L.) In Al-Qadmous Region, Syria. Int J Pharm Sci Res 2014; 5(12): 5177-82.doi: 10.13040/IJPSR.0975-8232.5 (12).5177-82**.**