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RESEARCH ARTICLE

Chemical composition of essential oil from the aerial parts of *Santolina rosmarinifolia* L. a wild Algerian medicinal plant

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Abstract

The analysed essential oil in this study was obtained by hydrodistillation from the aerial parts of *Santolina rosmarinifolia* L. (Asteraceae) collected from Hodna area of Algeria. This species is a medicinal herb traditionally used in Algeria. Its essential oil has been analyzed by combining GC-FID and GC-MS. The analysis led to the identification of eighty-two components, representing 91.84% of the whole composition of the sample. The main components were capillene (32.8%), 1,8-cineole (15.1%) and β-myrcene (14.0%).

Keywords: *Santolina rosmarinifolia* L., Asteraceae, Essential oil, GC-MS Analysis, Algeria

Introduction

The *Santolina* L. is a genus belonging to the Asteraceae family (formerly known as the family Compositae, tribe Anthemideae). It is characterized by over ten widely distributed species in the Mediterranean region (Derbesy et al., 1989). Rare in Algeria, the genus *Santolina* is represented by only one species, *Santolina rosmarinifolia* L., called rosemary leaves; a polymorphous plant colonizing forests, pastures and mountainous regions. It is a sub-bushy shrub with closely linear leaves, all tubular flowers, hermaphrodite (peripheral anther sometimes sterile). Inflorescence in dense corymbs, monocle branches and woody stems (Quezel & Santa, 1963). Known in Algeria as Qeissoum and Jaeda (Quezel & Santa, 1963; Baba Aissa, 1999).

Some species of the genus *Santolina* such as *S. chamaecyparissus* L., *S. etrusca* (Lacaita) Marchi & D'Amato, *S. insularis* (Gennari ex Fiori) Arrigoni, *S. neapolitana* Jord. & Fourr. and *S. oblongifolia*Boiss. have been reported in traditional medicine in Spain, Italy, Mediterranean area and India, (Tundis & Loizzo, 2018). In the Algerian traditional pharmacopoeia, *S. rosmarinifolia*L. is used in the treatment of dermatoses in the form of a decoction (Beniston & Beniston, 1984). Also, recommended in the form of flower bouquets arranged in cabinets to protect the linen against moths (Baba Aissa, 1999). These aerial parts are indeed used as vermifuge, stomachic, antispasmodic (Beloued, 2005) and widely pre-registered traditionally as a healing plant (Boudjelal et al., 2013; Sarri et al., 2014). Several *Santolina* species have been studied for their antimicrobial, antifungal, antiviral, and anti-inflammatory activities (Tundis & Loizzo, 2018).The infusion from *S. rosmarinifolia* fresh or dried flower heads was reported to have antipyretic, antihypertensive, hepatoprotective and intestinal anti-inflammatory properties (Ioannou et al., 2007).

This study reports the essential oil composition of *S. rosmarinifolia* from Hammam Dalaa (M'sila Provence) with a distinct chemical profile for the first time.

Materials and Methods

Plant material

The aerial parts of *Santolina rosmarinifolia* L. (Asteraceae) were collected in Hammam Dalaa (M'sila Provence) in May 2017. Avoucher specimen (SD2832/17) was deposited at the Herbarium of the Department of Nature and Life Sciences, Mohamed Boudiaf University (M'sila, Algeria).

Essential oil extraction

Washed aerial parts of the *S. rosmarinifolia* were dried at room temperature in a shady place and then ground to a powder form. The essential oil of the aerial parts of the *S. rosmarinifolia* (300 g) was obtained by hydrodistillation in Clevenger-type apparatus. This operation was carried out for 3 hours. The oil yield was 0.15%, as estimated on the dry weight basis (v/w).

Analysis of the essential oil

On a Hewlett-Packard gas-chromatograph model 5890, fitted with a flame ionization detector, gas chromatographic (GC) analysis was performed (FID). Analyses of GC-FID were carried out under the following analytical conditions: ZB-5 capillary column (30 m x 0.25 mm i.d. x 0.25 μm film thickness); helium as carrier gas; split mode injection (1:50); 250 and 280°C as injector and detector temperatures, respectively. A programmed oven temperature (40°C to 300 at 2°C/min) was applied.

On the same gas chromatograph, the gas chromatography-mass spectrometry (GC-MS) was performed in connection with a Hewlett-Packard mass spectrometer (model 5971A), 70eV ionization energy, 180°C ion source temperature, mass spectra data were collected over the scan mode in *m/z* range 40-400.

The individual volatile constituents were identified by comparison of their identical retention indices with those of the compounds known from literature data (Adams, 2007). Furthermore, the chemical identification was confirmed by computer matching of spectral MS data with those stored in the Wiley 275 library and the comparison of the fragmentation patterns with those reported in literature.

Results and Discussion

Chemical composition of the essential oil

Table 1 summarizes the composition and percentage of the essential oil compounds. They have been grouped according to the following classes of components: monoterpene hydrocarbons, oxygenated monoterpenes, sesquiterpenes and others, the last class comprises only the non-terpenoid compounds characterized in the essential oil. On the whole, eighty-two compounds were found, accounting for 91.84% of the total oil.

The most plentiful class in the essential oil of the Algerian *Santolina* was the 'others' amounting to *ca.* 35% with 17 components, oxygenated monoterpenes was the second class with *ca.* 22% and 24 components, the following class was monoterpene hydrocarbons with 13 components and an amount of *ca.* 21%, sesquiterpenes was the last class with the lowest amount (*ca.* 13%) but with the highest number of components (28). The main constituents were identified as capillene (32.79%), 1,8-cineole (15.08%) and β-myrcene (13.98%).

Species of the genus *Santolina*, particularly *S. rosmarinifolia* and its subspecies, clearly exhibit remarkable variability in terms of essential oil chemical composition (Table 2). This variability is very clear while comparing the major compounds of *S. rosmarinifolia* harvested in a steppe biotope (region of Hodna) which is the subject of this study to that harvested in another forest biotope (Aures region). In this context,

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Mehalaine & Chenchouni (2018) showed that certain climatic factors in regions with a semiarid climate had an effect on the quality and composition of the essential oil. This last sample, in fact, showed the presence of two components not found in our sample, namely tricosane (10.6%) and pentacosane (6.7%); a further significant difference was the consistent presence of germacrene-D and α-pinene (30.2 and 10.1%, respectively), together with the absence of capillene (Chibani et al., 2013). A greater similarity with compositional data of our sample has been reported for a sample of *S. rosmarinifolia* ssp. *rosmanifolia* (Palà-Paùl et al., 1991, 2001). The phytochemical analysis of *S. rosmarinifolia* collected in Portugal showed that almost all the main compounds found in our sample were present but in lower amount (Ioannou et al., 2007). The flowers oils of *S. rosmarinifolia* collected in Spain presented some similarities when compared with our sample, which in turn did not show the presence of *ar*-curcumene and β-eudesmol (Pérez-Alonso & Velasco-Negueruela, 1988). Finally, some other reports on different species of *Santolina* showed the presence of some components such as 1,8-cineole (Villar et al., 1986; Giner et al., 1933; Cherchi et al., 2001; Flamini & Cioni, 2007; Tirillini et al., 2007; Grosso et al., 2009), β-myrcene (Poli et al., 1997; Zaiter et al., 2015) and capillene (Malti et al., 2019).

Table 1: Chemical composition of essential oil from aerial parts of *Santolina rosmarinifolia* L.

#.[a]	Class/Compounds	RI[b]	%[c]
	Monoterpene hydrocarbons		**20.9**
4	α-Thujene	932	0.1
5	α-Pinene	939	1.3
6	Camphene	955	0.3
7	Thuja-2,4(10)-diene	960	t
9	Sabinene	979	0.7
10	β-Pinene	983	3.5
11	β-Myrcene	997	14.0
12	Phellandrene	1009	t
13	α-Terpinene	1021	0.4
14	*p*-Cymene	1029	0.3
16	β-*Z*-Ocimene	1049	t
19	γ-Terpinene	1072	0.3
22	Terpinolene	1093	0.1
	Oxygenated monoterpenes		**22.3**
15	1,8-Cineole	1041	15.1
21	*cis*-Sabinene hydrate	1089	0.2
23	Perillene	1100	0.5
25	Dehydro sabina ketone	1126	0.1
26	α-Campholenal	1130	0.1
28	*trans*-Pinocarveol	1146	0.5
29	Camphor	1151	1.0
30	Karahanaenone	1164	t
31	Sabina ketone	1166	t
32	*cis*-Chrysanthenol	1172	2.0
33	Borneol	1175	0.1
34	*cis*-Pinocamphone	1182	t
35	Terpinen-4-ol	1186	1.5

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36	Thuj-3-en-10-al	1192	0.1
38	α-Terpineol	1199	0.9
39	Myrtenol	1205	0.4
40	*trans*-Carveol	1227	t
41	*cis*-Carveol	1237	t
44	Geranial	1278	t
45	*p*-Menth-1-en-7-al	1283	t
46	*cis*-Verbenyl acetate	1286	t
47	γ-Terpinen-7-al	1287	t
48	Perilla alcohol	1306	0.1
49	Myrtenyl acetate	1334	t
	Sesquiterpenes		**13.0**
51	α-Copaene	1388	t
52	Bourbonene	1390	t
53	*Z*-Jasmone	1395	0.1
55	α-Gurjunene	1408	t
56	β-Caryophyllene	1422	t
57	β-Copaene	1431	0.1
58	*trans*-α-Bergamotene	1445	0.1
59	β-Farnesene	1464	t
60	Sesquisabinene	1471	0.1
61	γ-Gurjunene	1484	0.1
62	γ-Muurolene	1488	0.2
63	Curcumene	1489	0.2
64	Germacrene D	1496	t
66	γ-Cadinene	1526	t
67	Δ-Cadinene	1535	0.4
69	Sphatulenol	1595	3.2
70	Globulol	1598	0.2
71	Salvial-4(14)-en-1-one	1608	0.3
72	Carotol	1618	0.2
73	Oplopenone	1623	0.1
74	β-Atlantol	1626	0.3
75	β-Acorenol	1638	t
76	γ-Eudesmol	1641	t
78	3-Thujopsanone	1657	2.1
79	Eudesma-4(15)-7-dien-1-β-ol	1698	0.3
80	5-neo-Cedranol	1703	0.5
81	Eudesma-4,11-dien-2-ol	1706	3.4
82	β-Acorenone	1708	1.7
	Others		**35.29**
1	3-Hepten-1-ol acetate	773	t
2	Hexanal	803	t
3	*E*-2-hexenal	859	t
8	Benzaldehyde	966	0.4

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17	Benzene acetaldehyde	1058	t
18	2-Octen-2-methyl-6-methylene[d]	1063	0.7
20	Acetophenone	1077	t
24	Isopentylisovalerate	1103	t
27	4- acetyl-1-methylcyclohexane[d]	1135	0.1
37	3,3,5-Trimethyl-1,4-hexadiene[d]	1195	0.1
42	*cis*-3-Hexenyl isovalerate[d]	1249	0.1
43	*p*-Ethylacetophenone	1262	t
50	Decanoic acid[d]	1377	t
54	Methyl eugenol	1402	0.1
65	Capillene[d]	1519	32.8
68	Hexenylbenzoate	1580	0.1

[a] The numbering refers to elution order on ZB-5 capillary column; [b] Retention index relative to standard mixture of *n*-alkanes on ZB-5 capillary column; [c] Values (area%) represent averages of three determinations (t = trace, <0.05%); [d] Tentatively identified by MS data only.

Table 2. Principal volatile constituents (%) in the essential oils of some specimens of *S. rosmarinifolia* L. and *S. rosmarinifolia* L. ssp. *rosmarinifolia*

Origin / Status / Nature	Part used	Principal components (%)	References
Batna-Aures (Algeria) - *Santolina rosmarinifolia* L. / Wild	Flowering aerial parts	germacrene-D (30.2), β-myrcene (12.0), tricosane (10.6), β-pinene (10.1), sabinene (7.0) and pentacosane (6.7).	Chibani et al., 2013
Botanical Gardens of Iasi (Romania) / *Santolina rosmarinifolia* L. / Cultivated	Flower heads	β-eudesmol (13.5), 1,8-cineole (12.9), camphor (8.0), borneol (5.1), *ar*-curcumene (4.8), terpinen-4-ol (4.5), spathulenol (4.4)	Ioannou et al., 2007
	Leaves	*ar*-curcumene (9.6), β-phellandrene (8.1), spathulenol (7.5), β-pinene (6.0), γ-muurolene (5.8), myrcene (5.2), camphor (5.2).	
Puente de Madrid (Spain) / *Santolina rosmarinifolia* L. ssp. *rosmarinifolia* / Wild	Aerial parts(*)	Sabinene (0.3-12), β-pinene (17.0-26.5), myrcene (0.3-15.5), β-phellandrene (14.4-27.6), limonene (3.1-5.0), 1,8-cineole (0.9-1.7), artemisia ketone (1.0-2.4), terpinen-4-ol (0.5-4.0), capillene (t-5.1), *ar*-curcumene (1.0-2.4), β-eudesmol (0.4-5.0).	Palá-Paúl et al., 2001
Puerto de Nava-cerrad a Madrid (Spain) / *Santolina rosmarinifolia* L. ssp. *rosmarinifolia* / Wild	Aerial parts	capillene (35.2), β-phellandrene (14.9), myrcene (13.1), β-pinene (7.8), sabinene (5.5), *ar*-curcumène (4.3)	Palá-Paúl et al., 1999
El Escorial and Puerto de Galapagar a Madrid (Spain) / *Santolina rosmarinifolia* L. / Wild	Flowers	1,8-cineole (8.9), β-pinène (8.9), myrcene (7.8), sabinene (6.6), *ar*-curcumene (5.8), β-eudesmol (13.4).	Pérez-Alonso & Velasco-Negueruela, 1988

(*) Components of the EO (in %) of *Santolina rosmarinifolia* L. *ssp. rosmarinifolia* over one year (min-max); t=traces

Conclusion

This study forms the first report on the chemical composition of the essential oil from *Santolina rosmarinifolia* L. harvested in a steppe biotope. The obtained results could contribute to the valorisation of this Algerian medicinal plant.

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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