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SHORT COMMUNICATION



Essential oil composition of aerial parts from Algerian *Anacyclus monanthos* subsp. *cyrtolepidioides* (Pomel) Humphries

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ABSTRACT

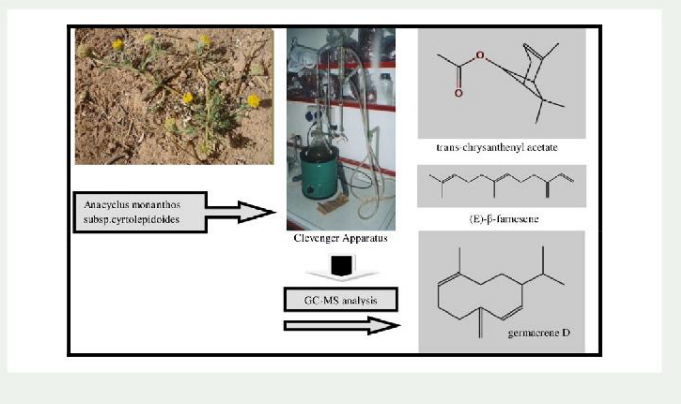
The chemical composition of the essential oil from the aerial parts of *Anacyclus monanthos* subsp. *cyrtolepidioides* (Pomel) Humphries (Asteraceae) growing in a semi-arid region of Algeria was investigated for the first time. The essential oil was obtained by hydrodistillation and fully characterized by gas chromatography-mass spectrometry (GC-MS). A total of 97 compounds were identified. The essential oil was found to be rich in *trans*-chrysanthenyl acetate ($9.8 \pm 2.0\%$), (*E*)- β -farnesene ($7.4 \pm 1.5\%$), germacrene D ($6.9 \pm 1.3\%$) and myristicin ($4.8 \pm 0.8\%$).

ARTICLE HISTORY

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KEYWORDS


Anacyclus monanthos subsp. *cyrtolepidioides* (Pomel) Humphries; Asteraceae; essential oil composition; GC-MS; Algeria



1. Introduction

Anacyclus monanthos subsp. *cyrtolepidioides* (Pomel) Humphries belongs to the Asteraceae family and represents one out of six indicated species of the *Anacyclus* genus widely

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distributed in Algeria. Six synonyms has been reported for *Anacyclus monanthos* subsp. *cyrtolepidioides*: *Anacyclus alexandrinus* var. *cyrtolepidioides* (Pomel) Durand & Baratte, *Anacyclus alexandrinus* var. *mauritanicus* (Pomel) Batt., *Anacyclus cyrtolepidioides* Pomel, *Anacyclus cyrtolepidioides* var. *cyrtolepidioides*, *Anacyclus cyrtolepidioides* var. *mauritanicus* (Pomel) Batt. ex. Jahand. & Maire and *Anacyclus mauritanicus* Pomel (The Plant List 2013). It is an annual, pubescent plant, ligules present or absent. Central florets usually with 2 erect teeth longer and 3 spread; devices with 5 equal teeth. Outer achenes with a \pm marked crown, discoid homogamous flower heads; with grayish leaves and flexuous stems. Leaves are 1–2 pinnatipartite, with elongated, linear segments. Flowers are grouped in capitula arranged on short terminal peduncles; they are all tubular, 5-toothed. *A. monanthos* subsp. *cyrtolepidioides* is endemic to North Africa. In Algeria, it grows on sandy soils of regions characterized by semi-arid climate; it is quite common, especially in subsector of Algerian and Oranais high plateaus (H1), Constantine high plateaus (H2) and Eastern regions of the Northern Sahara (SS2). After identification of the specimen a new station of this species has been recently suggested in Hodna region (Hd). In Algeria, this species is known as vernacular: Djerf and Rebina and no particular traditional use of this plant is reported (Quezel and Santa 1963).

In Tunisia, some studies show that the essential oil from flowerheads of *A. cyrtolepidioides* has insecticidal and antimicrobial activities (Zardi-Bergaoui, Hammami et al. 2008, Zardi-Bergaoui, Harzallah-Skhiri et al. 2008). To the best of our knowledge, In Algeria, the secondary metabolites of this species have not been investigated yet. In particular, the volatile fraction is often useful to support the chemotaxonomy of the species. Therefore, in this work we reported the first investigation of the chemical composition of the essential oil obtained from the aerial parts of the *A. monanthos* subsp. *cyrtolepidioides* growing in Algeria.

2. Results and discussion

Table S1 lists the chemical composition of the *A. monanthos* subsp. *cyrtolepidioides* essential oil. In total, 97 volatile components, accounting for 70.4% of the total composition, were fully characterized and grouped into eight classes, namely: aldehydes, alkanes, monoterpene hydrocarbons, oxygenated monoterpenes, sesquiterpene hydrocarbons, oxygenated sesquiterpenes, diterpenes, phenylpropanoids and others. The essential oil was characterized by sesquiterpene hydrocarbons (17 compounds accounting for 24.6% of the total composition), oxygenated monoterpenes (28 compounds, 15.6% of the total composition), oxygenated sesquiterpenes (13 compounds, 13.1% of the total composition), phenylpropanoids (2 compounds, 4.8% of the total composition), monoterpene hydrocarbons (11 compounds, 4.0% of the total composition), diterpenes (2 compounds, 2.6% of the total composition), alkanes (8 compounds, 2.2% of the total composition) and aldehydes (9 compounds, 1.0% of the total composition). The major constituents (in order of decreasing amount) were *trans*-chrysanthenyl acetate (9.8%), (*E*)- β -farnesene (7.4%), germacrene D (6.9%), myristicin (4.8%), vulgarone B (3.6%), spathulenol (2.8%), β -sesquiphellandrene (2.7%) and neryl isovalerate (2.0%).

A review of the existing literature on essential oils of the genus *Anacyclus* revealed the presence of a few studies. The group of oxygenated sesquiterpenes of the Moroccan species *A. pyrethrum* constitutes the most abundant fraction of the oil (89.2–90.6%) during the maturation stage (Elazzouzi et al. 2014) likewise; this group is the most abundant in the Algerian

species as shown by Selles et al. (2013). In this study, the percentage of oxygenated sesquiterpenes increased from 37.1 to 58.6% before and after flowering, respectively. In contrast, the essential oil of the Tunisian species *A. clavatus* is characterized by the predominance of the group of oxygenated monoterpenes with 54.03% of the total composition, the major constituents of this fraction are *trans*-chrysanthenyl acetate (12.3%), *cis*-thuyone (9.8%), chrysanthenone (8.2%) and *trans*-thuyone (7.3%) (Hammami et al. 2013). Whereas in that of an Algerian population, Aliboudhar et al. (2013, 2015) showed that the oxygenated fraction represented 36.1% and the main components are germacrene D (16.84%) and β -thujone (11.16%). By comparison, *A. cyrtolepidoïdes* shows a low content of both groups (oxygenated sesquiterpenes: 13.1%; oxygenated monoterpenes: 15.6%), and high levels of sesquiterpene hydrocarbons (24.6%).

Other chemical investigation of butanol and acetone extracts from Tunisian *Anacyclus cyrtolepidoïdes* identified new compounds: rutin 1, nicotoflorin 2, methyl linoleate 3, linoleic, palmitic and linolenic acids (Hammami et al. 2011).

We have to mention here that another extraction technique of essential oil (extracted and separated by fractions) done on the *Anacyclus cyrtolepidoïdes* shows a quite different results from ours. This technique is used by Zardi-Bergaoui, Harzallah-Skhiri et al. (2008), who identified seventy-five compounds (four fractions F₁-F₄), were identified by GC and GC-MS. α -pinene (71.4, 46.5, 80.3 and 63.7%) as the major constituent in the four fractions. Decanal (8.0%), β -cubebene (5.6%) and Compholenal (5.3%) were found at the highest value in F₂, but the compound 9-hexacosene (15.7%) was found at the highest value in F₄.

3. Experimental

See Supplementary Material.

4. Conclusion

This work is the first report on the essential oil composition of *A. monanthos* subsp. *cyrtolepidoïdes* growing in Algeria. The GC-MS analysis of the oil allowed us to identify *trans*-chrysanthenyl acetate (9.8%), (*E*)- β -farnesene (7.4%), germacrene D (6.9%) and myristicin (4.8%) as the major compounds. These results shed light into the phytochemistry of this unexplored species of the Flora of Algeria. The second step will be to evaluate the biological activities of the essential oil in order to valorize this endemic species with a special ecological character.

Disclosure statement

No potential conflict of interest was reported by the authors.

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SUPPLEMENTARY MATERIAL

Essential oil composition of aerial parts from Algerian *Anacyclus monanthos* subsp. *cyrtolepidioides* (Pomel) Humphries

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Abstract

The chemical composition of the essential oil from the aerial parts of *Anacyclus monanthos* subsp. *cyrtolepidioides* (Pomel) Humphries (Asteraceae) growing in a semi-arid region of Algeria was investigated for the first time. The essential oil was obtained by hydrodistillation and fully characterized by gas chromatography-mass spectrometry (GC-MS). A total of 97 compounds were identified. The essential oil was found to be rich in *trans*-chrysanthenyl acetate (9.8±2.0%), (*E*)-β-farnesene (7.4±1.5%), germacrene D (6.9±1.3%) and myristicin (4.8±0.8%).

Keywords: *Anacyclus monanthos* subsp. *cyrtolepidioides* (Pomel) Humphries, Asteraceae, essential oil composition, GC-MS, Algeria

Experimental

Plant material: *Anacyclus monanthos* subsp. *cyrtolepidioides* (Pomel) Humphries (Fig. 2) was collected in Chott El Hodna region (altitude, 394 m), M'sila, Algeria, in April 2017. The sample was composed of the aerial parts from 25–50 plants which were representative of the geographic area of distribution of the species. A voucher specimen (QSAc 2850) was identified by Dr. Dj. Sarri and Dr. A. Zedam (Department of Nature Sciences and Life, Department of Agronomic Sciences) and deposited in the herbarium of the Department of Nature Sciences and Life, Faculty of Sciences, M'sila University, Algeria.

Analysis of the oil: Air-dried aerial parts of the plant (300 g) were subjected to hydrodistillation in a Clevenger-type apparatus until there was no significant increase in the volume of oil collected (3 h). The oil yield, estimated on a dry matter (v/w) was 0.18%. Separation and analysis of *A. monanthos* subsp. *cyrtolepidioides* (Pomel) Humphries essential oil components were achieved on an Agilent 6890N gas chromatograph coupled to a 5973N mass spectrometer and

equipped with a HP-5 MS (5% phenylmethylpolysiloxane, 30 m, 0.25 mm i.d., 0.1 µm film thickness; J & W Scientific, Folsom) capillary column. The temperature programme used was as follows: 5 min at 60 °C then 4°C/min up to 220°C, then 11°C min⁻¹ up to 280°C, held for 15 min. Injector and detector temperatures: 280°C; carrier gas: He; flow rate: 1 ml/min; split ratio: 1:50; acquisition mass range: 29–400 m/z; mode: electron-impact (EI, 70 eV). The essential oil was diluted 1:100 in *n*-hexane, and then 2 µl of the solution were injected into the GC-MS system. For identification of essential oil components, co-injection with the above standards was used, together with correspondence of retention indices and mass spectra with respect to those occurring in ADAMS, NIST 08 and FFNSC2 libraries (Adams, 2007, NIST 08, 2008, FFNSC2, 2012). Semi-quantification of essential oil components was made by peak area normalization considering the same response factor for all volatile components. Percentages values were the mean of three chromatographic analyses.

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Figure S1: *Anacyclus monanthos* subsp. *cyrtolepidioides* (Pomel) Humphries
(taken by Dj. Sarri in 11.04.2017)



Table S1. Chemical composition of the essential oil from *Anacyclus monanthos* subsp.*cyrtolepidioides* (Pomel) Humphries

Group/Component ^a	RI ^b	RI LIT ^c	% ^d	ID ^e
Aldehydes			1.0±0.2	
(2 <i>E</i>)-heptenal	951	947	Tr ^f	RI,MS
benzaldehyde	954	952	Tr	RI,MS
<i>n</i> -octanal	1004	998	0.1±0.0	Std,RI,MS
benzene acetaldehyde	1042	1036	Tr	RI,MS
(2 <i>E</i>)-octen-1-al	1058	1049	Tr	RI,MS
<i>n</i> -nonanal	1104	1100	0.4±0.1	Std,RI,MS
<i>n</i> -decanal	1206	1201	0.2±0.0	Std,RI,MS
(2 <i>E</i>)-decanal	1261	1260	0.1±0.0	RI,MS
(2 <i>E</i> ,4 <i>E</i>)-decadienal	1314	1315	0.1±0.0	RI,MS
Alkanes			2.2±0.4	
<i>n</i> -tetradecane	1399	1400	0.1±0.0	Std,RI,MS
<i>n</i> -pentadecane	1499	1500	Tr	Std,RI,MS
<i>n</i> -tricosane	2297	2300	0.9±0.2	Std,RI,MS
<i>n</i> -tetracosane	2397	2400	Tr	Std,RI,MS
<i>n</i> -pentacosane	2528	2500	0.5±0.1	Std,RI,MS
<i>n</i> -hexacosane	2597	2600	Tr	Std,RI,MS
<i>n</i> -heptacosane	2695	2700	0.4±0.1	Std,RI,MS
<i>n</i> -nonacosane	2900	2900	0.2±0.0	Std,RI,MS
Monoterpene hydrocarbons			4.0±0.9	
santolina triene	906	906	0.2±0.0	RI,MS
α -pinene	926	932	1.2±0.4	Std,RI,MS
camphene	939	946	Tr	Std,RI,MS
sabinene	966	975	0.1±0.0	Std,RI,MS
β -pinene	968	974	0.9±0.2	Std,RI,MS
myrcene	989	988	0.4±0.1	Std,RI,MS
δ -2-carene	996	1001	0.6±0.2	RI,MS
<i>p</i> -cymene	1021	1020	0.1±0.0	Std,RI,MS
limonene	1025	1024	0.5±0.1	Std,RI,MS
γ -terpinene	1055	1054	Tr	Std,RI,MS
<i>p</i> -cymenene	1086	1089	Tr	RI,MS
Oxygenated monoterpenes			15.6±3.2	
yomogialcohol	1002	999	0.1±0.0	RI,MS
1,8-cineole	1028	1026	0.1±0.0	Std,RI,MS

artemisia ketone	1060	1056	0.2±0.0	RI,MS
artemisia alcohol	1083	1080	Tr	RI,MS
<i>p</i> -mentha-2,4(8)-diene	1084	1085	Tr	RI,MS
linalool	1100	1095	Tr	Std,RI,MS
<i>trans-p</i> -mentha-2,8-dien-1-ol	1118	1119	0.1±0.0	RI,MS
α -campholenal	1123	1122	0.1±0.0	RI,MS
<i>trans</i> -pinocarveol	1132	1135	0.4±0.1	Std,RI,MS
<i>trans</i> -verbenol	1140	1140	0.5±0.1	RI,MS
pinocarvone	1157	1160	0.3±0.1	RI,MS
<i>cis</i> -chrysanthenol	1160	1160	0.2±0.0	RI,MS
borneol	1160	1165	0.2±0.0	Std,RI,MS
<i>p</i> -mentha-1,5-dien-8-ol	1165	1166	Tr	RI,MS
<i>cis</i> -pinocamphone	1168	1172	0.1±0.0	RI,MS
terpinen-4-ol	1173	1174	0.1±0.0	Std,RI,MS
3,7-octadiene-2,6-diol, 2,6-dimethyl-	1184	1186	0.5±0.1	RI,MS
α -terpineol	1187	1186	0.1±0.0	Std,RI,MS
myrtenal	1191	1195	0.2±0.0	Std,RI,MS
myrtenol	1191	1194	0.2±0.0	Std,RI,MS
<i>trans</i> -carveol	1216	1218	0.1±0.0	RI,MS
<i>cis-p</i> -mentha-1(7),8-dien-2-ol	1225	1227	Tr	RI,MS
<i>trans</i>-chrysanthenyl acetate	1233	1235	9.8±2.0	RI,MS
carvone	1240	1239	0.1±0.0	Std,RI,MS
<i>cis</i> -chrysanthenyl acetate	1259	1261	0.1±0.0	RI,MS
thymol	1294	1289	0.1±0.0	Std,RI,MS
carvacrol	1302	1298	Tr	Std,RI,MS
nerylisovalerate	1584	1582	2.0±0.4	RI,MS
<i>Sesquiterpene hydrocarbons</i>			24.6±4.8	
α -longipinene	1340	1350	0.8±0.2	RI,MS
α -copaene	1367	1374	0.3±0.0	Std,RI,MS
(<i>E</i>)-caryophyllene	1408	1417	1.6±0.4	Std,RI,MS
β -copaene	1419	1430	0.1±0.0	RI,MS
γ -elemene	1427	1434	0.2±0.0	RI,MS
α - <i>trans</i> -bergamotene	1430	1432	Tr	RI,MS
α -humulene	1442	1452	0.2±0.0	Std,RI,MS
(<i>E</i>)- β -farnesene	1456	1454	7.4±1.5	Std,RI,MS
germacrene D	1471	1484	6.9±1.3	RI,MS

β -selinene	1475	1489	0.2 \pm 0.0	RI,MS
bicyclogermacrene	1485	1500	0.7 \pm 0.2	RI,MS
α -zingiberene	1494	1493	0.3 \pm 0.1	RI,MS
β -bisabolene	1504	1505	0.2 \pm 0.0	RI,MS
(<i>E,E</i>)- α -farnesene	1507	1505	1.8 \pm 0.4	Std,RI,MS
β-sesquiphellandrene	1517	1521	2.7\pm0.5	RI,MS
α -calacorene	1535	1544	0.2 \pm 0.0	RI,MS
germacrene B	1545	1559	1.1 \pm 0.2	RI,MS
<i>Oxygenates sesquiterpenes</i>			13.1\pm2.5	
10,11-epoxy-calamenene	1485	1500	0.7 \pm 0.1	RI,MS
spathulenol	1567	1577	2.8\pm0.4	RI,MS
caryophylleneoxide	1570	1582	1.6 \pm 0.3	Std,RI,MS
salvial-4(14)-en-1-one	1584	1594	0.8 \pm 0.1	RI,MS
β -oplophenone	1599	1607	0.7 \pm 0.1	RI,MS
1,10- <i>di-epi</i> -cubenol	1618	1618	1.1 \pm 0.2	RI,MS
<i>epi</i> - α -muurolol	1632	1640	0.5 \pm 0.1	RI,MS
vulgarone B	1636	1649	3.6\pm0.7	RI,MS
α -cadinol	1645	1652	0.6 \pm 0.2	RI,MS
<i>cis</i> -calamenen-10-ol	1658	1660	0.3 \pm 0.1	RI,MS
<i>epi</i> - α -bisabolol	1679	1683	0.2 \pm 0.0	RI,MS
14-hydroxy- α -muurolene	1768	1779	0.1 \pm 0.0	RI,MS
14-hydroxy- δ -cadinene	1793	1803	0.2 \pm 0.0	RI,MS
<i>Diterpenes</i>			2.6 \pm 0.6	
neophytadiene	1837	1838*	1.0 \pm 0.2	RI,MS
<i>trans</i> -phytol	2102	2104	1.5 \pm 0.3	Std,RI,MS
<i>Phenylpropanoids</i>			4.8\pm0.9	
(<i>E</i>)-anethole	1282	1282	Tr	Std,RI,MS
myristicin	1517	1517	4.8\pm0.8	Std,RI,MS
<i>Others</i>			2.4 \pm 0.5	RI,MS
2-pentyl furan	989	984	0.4 \pm 0.1	RI,MS
<i>n</i> -octanol	1073	1063	Tr	RI,MS
mintsulfide	1720	1740	0.2 \pm 0.0	RI,MS
benzylbenzoate	1754	1759	0.1 \pm 0.0	RI,MS
hexahydrofarnesyl acetone	1843	1845	0.6 \pm 0.1	RI,MS
<i>n</i> -hexadecanoic acid	1964	1959	0.8 \pm 0.2	Std,RI,MS
(<i>Z</i>)-falcarinol	2029	2035	0.2 \pm 0.0	RI,MS
Total identified (%)			70.4 \pm 3.1	

^a Compounds are listed in order of their elution from a HP-5MS column. ^b Linear retention index on HP-5MS column, experimentally determined using homologous series of C₈-C₃₀ alkanes. ^c Linear retention index taken from Adams (2007) or NIST 08 (2008) and literature (for neophytadiene). ^d Relative percentage values are means of three determinations \pm SD. ^e Identification methods: Std, based on comparison with authentic compounds; MS, based on comparison with WILEY, ADAMS, FFNSC2 and NIST 08 MS databases; RI, based on comparison of calculated RI with those reported in ADAMS, FFNSC 2 and NIST 08. ^f Tr., % below 0.1%.