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Comparative Essential Oil Composition Of Flowers And Leaves of *Warionia saharae* Benth. & Coss.

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ABSTRACT

The chemical composition of leaves and flowers of *Warionia saharae* Bent.&Coss., have been examined by GC and GC–MS, the identified components constituting 95.3% and 84.1 % of the leaves and flowers oils respectively. The main constituents of leaves oil were linalool (27.7%), β-eudesmol (25.7%), (E)-nerolidol (8.4%), geraniol (7.1%), α-terpineol (5.5%) , nerol (2.4%), eremoligenol (2.1%), α-agarofurane (1.7%) , 1,8-cineol (1.4%) and limonene (1.3%) while nerolidol (29.6%), β-eudesmol (28.5%), farnesol (8.2%), linalool (3.4%), β-caryophyllene (3.1%), eremoligenol (2.5%), acorenone (2.1%) were established as the main components of the flowers. These results differ from the few previous studies reported on this species.

Keywords: *Warionia saharae*, essential oil, linalool, nerolidol, β-eudesmol, geraniol, α-terpineol, farnesol.

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INTRODUCTION

Warionia saharae Benth. & Coss. is an endemic species of North Africa which grows in Southwest Algerian Sahara in the region of Beni Ounif, Zousfana and Bechar [1]. It was also found in various regions of the south of Morocco [2]. The leaves of *Warionia saharae* are used in traditional medicine to treat inflammatory diseases, gastrointestinal disorders and against epileptic crisis [10-11]. Crude extracts of this plant showed anti-inflammatory and cytotoxic activities against a cancer cell line (KB cells) [3-4]. The methanolic soluble fraction of the dichloromethane extract of *Warionia saharae* afforded cytotoxic and anti-inflammatory sesquiterpene lactones [3-5], while hexanoic extract showed the presence of several hydrocar bon acid derivatives [6]. The composition of the essential oil of the aerial parts of this species from Morocco was also studied [7-9]. The main constituents reported were β-eudesmol (34.9-52.7%), (E)-nerolidol (17.4-23%), linalool (5.1- 15.2 %) and at least extent, guaiol (2.4%), terpinen-4-ol (1.4-1.8%) and 1,8-cineol (0.4-1.2%) [7-9]. Herein, we report our results on the composition of the essential oils of the leaves and flowers of a sample of *Warionia saharae* collected in the Southwest Algerian Sahara which were generally different from those reported previously on this species.

MATERIALS AND METHODS

EXPERIMENTAL

Plant materiel

The present sample was collected in April 2011 from flowering plants from the Daya of Mogheul at forty km from Bechar in the Southwest of Algeria and identified by M. Benabdelhakem from the National Agency of Preservation of Natural Resources of Bechar. Voucher specimens are kept in the Herbarium of The research Unity of Valorization of Natural Resources and Bioactive Molecules, University of Constantine, (WRS-N°125-2011).

Isolation of the essential oils

The leaves (200g) and the flowers (350g) of *Warionia saharae* were separately steam distilled in a Kaiser Lang apparatus.

GC and GC-MS analysis

The essential oils were analyzed on an Agilent gas chromatograph (GC-FID) Model 6890, equipped with a HP-5 ms fused silica capillary column having (5%-phenyl) methylpolysyloxane stationary phase (25 m x 0.25 mm, film thickness 0.25 μm), programmed from 50°C (5 mn) to 250 °C at 3°/mn and held for 10 mn . Injector and flame ionization detector temperatures were 280 and 300 °C, respectively. The essential oils were diluted in acetone 3.5% (v/v) and injected in split mode (1/60), helium was used as a carrier gas (1.0 mL/mn). Solutions of standard

alkanes (C_8-C_{20}) was analyzed under the same conditions to calculate retention indices (RI) with Van del Dool and Kratz equation.

Mass spectrometry was performed on an Agilent gas chromatograph-mass spectrometer (GCMS) Model 7890/5975, equipped with HP-5 capillary column (25 m x 0.25 mm, film thickness 0.25 μm) programmed with the same conditions as for GC-FID. The mass spectrometer (MS) was in electron impact mode at 70 eV and electron multiplier was at 2200 V. Ion source and MS quadrupole temperatures were 230°C and 180°C, respectively. Mass spectral data were acquired in the scan mode in the *m/z* range 33-450. The essential oil constituents were identified by matching their mass spectra and retention indices (RI) with those of reference compounds from libraries such as Adams [12] and Mc Lafferty & Stauffer [13]. The proportions of the identified compounds were calculated by internal normalization.

RESULTS AND DISCUSSION

The yield of steam distillation was 0.95% for the leaves and 0.70% for the flowers (w/w) in relation to the dry weight of the plant. A total of forty and twenty five constituents were determined which account for about 94,3% and 84.1% of the essential oils of the two parts of *Warionia saharae* respectively. The components identified in the essential oils of the two parts are listed in table 1 in order of their experimental retention times and retention indices.

The major components of the two oils were limonene, 1,8-cineol, linalool, α-terpineol, nerol, geraniol, β-caryophyllene, α-agarofurane, acorenone, (E)-nerolidol, eremoligenol, β-eudesmol and (*Z,Z*)-farnesol. The main constituents of leaves oil were linalool (27.7%), β-eudesmol (25.7%), (E)-nerolidol (8.4%), geraniol (7.1%), α-terpineol (5.5%) , nerol (2.4%), eremoligenol (2.1%), α-agarofurane (1.7%), 1,8 cineol (1.4%) and limonene (1.3%), while (E)-nerolidol (29.6%), β-eudesmol (28.5%), (*Z,Z*)-farnesol (8.2%), linalool (3.4%), β-caryophyllene (3.1%), eremoligenol (2.5%), acorenone (2.1%) were established as the main components of the flowers. As seen, linalool (27.7%) was identified as the main highest constituent for leaves while it was found in much less extent in the flowers (3.4%). Conversely, (E)-nerolidol (29.6%) was the highest main constituent for flowers while it was found in less extent (8.4%) in the leaves. The proportion of β-eudesmol was high in both leaves and flowers (25.7 and 28.5% respectively) but it was found in less extent than in the previously reported Morocco samples [6-8].

The other main components for leaves were : α-terpineol (5.5%), nerol (2.4%), geraniol (7.1%), α-agarofurane (1.7%), eremoligenol (2.1%), limonene (1.3%) and I,8-cineol (1.4%) while caryophillene (3.1%) , farnesol (8.2%) , eremoligenol (2.5%) and acorenone (2.1%) were the other main components for flowers.

Monoterpenic hydrocarbons were present in relatively low proportion in the leaves (6.8%) but were totally absent in the flowers.

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The oxygenated fractions represented 84.7% and 78.4% of the total oil composition in the leaves and in the flowers respectively.

Table 1: Volatile oil composition of leaves and flowers of *Warionia saharae* (%)

RI	RT	Part		
		Compounds	Leaves	Flowers
902	9.02	heptanal	0.11	
930	9.88	α-thujene	0.15	
939	10.14	α-pinene	0.29	
976	11.53	sabinene	0.38	
980	11.70	β-pinene	0.21	
991	12.11	myrcene	0.89	
1003	12.67	α-phellandrene	0.16	
1018	13.05	α-terpinene	0.44	
1025	13.32	paracymene	0.28	
1029	13.47	limonene	1.37	
1031	13.59	1,8-cineol	1.47	0.14
1037	13.69	(Z)-β-ocimene	0.53	
1050	14.04	(E)-β-ocimene	0.92	
1060	14.44	γ-terpinene	0.84	
1073	14.86	trans linalol oxyde	0.08	
1089	15.31	terpinolene	0.92	
1097	15.83	linalool	27.76	3.46
1104	15.91	hotrienol (3,7-dimethyl-1,5,7-octatriene)		0.1
1114	16.38	β-thujone	0.11	
1122	16.58	cis-p- menth-2-en-1-ol	0.19	
1141	17.13	trans-p-menth-2-en-1-ol	0.18	
1177	18.29	terpinene-4-ol	0.85	0.33
1195	18.73	α-terpineol	5.52	0.62
1197	18.83	safranal		0.43
1204	19.00	decanal		0.22
1205	19.11	trans-piperitol	0.09	
1220	19.37	paramenthene-9-al	0.09	
1228	19.52	nerol	2.47	0.33
1255	20.26	geraniol	7.07	0.79
1389	24.02	β-elemene		0.25
1376	23.69	α-copaene	0,10	0.10
1385	23.79	(E)-β-damascone	0.31	
1386	23.91	β-bourbonene	0.36	
1403	24.22	methyl eugenol	0.19	
1407	24.44	3-methyl-1(2,5-dimethyl phenyl)butanone	0.37	
1421	24.83	β-caryophyllene	0.24	3.19
1434	25.11	trans-α-bergamotene	0.11	0.19
1455	25.43	geranylacetone	0.10	0.16
1459	25.73	α-humulene	0.13	0.36
1475	25.73	(E,Z)- α-farnesene	0.09	
1479	26.20	γ-curcumene		0.21
1481	26.28	ar-curcumene	0.15	0.28

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1490	26.53	pentadecene-1	0.32	
1495	26.72	α-zingiberene		0.30
1507	26.90	α-agarofurane	1.77	
1509	26.91	acorenone		2.10
1520	27.20	δ-cadinene		0.28
1558	28.07	2,6,10-trimethyl-7,10-epoxy-2,11-dodecadien-6-ol	0.19	
1564	28.17	(E)-nerolidol	8.41	29.69
1565	28.43	4,8,12-Trimethyldeca-1,3,7,11-tetraene		0.53
1581	28.75	caryophyllene oxide	0.16	
1631	29.84	eremoligenol (eremophil-1(10)-en-11-ol	2.05	2.52
1651	30.43	β-eudesmol	25.71	28.59
1718	31.60	(Z,Z)-farnesol		8.28
1763	32.82	lanceol		0.82

Our results were generally different from the three previously reported studies on the composition of the essential oil of *Warionia saharae* from Morocco. Linalool (27.7%) and (E)-nerolidol (29.6%) were found as the highest main constituents for the leaves and the flowers respectively, while β-eudesmol was found as the highest main constituent for all the Morocco samples (34.7 - 52.7%) [6-8]. Among the other main constituents (Table 2) 1,8-cineol, nerol, α-terpineol and β-caryophyllene were found in much less extent in the previous studies performed on the Morocco samples and (*Z,Z*)-farnesol (8.2%) , eremoligenol (2.5%), acorenone (2.1%) were described for the first time in the oil of *Warionia saharae* .

Table 2: Comparison of the proportions of the main constituents of *Warionia saharae*

RI	RT	Part			[7]	[8]	[6]
		Compounds	Leaves	Flowers	1	2	3
1029	13.47	limonene	1.37			0.8	0,1
1031	13.59	1,8-cineol	1.47	0.14		1.2	0,4
1097	15.83	linalool	27.76	3.46	8,63%	5.1	15,2
1195	18.73	alpha terpineol	5.52	0.62		0.5	2,7
1228	19.52	nerol	2.47	0.33		0.4	0,7
1255	20.26	geraniol	7.07	0.79			2,3
1421	24.83	β -caryophyllene	0.24	3.19		0.5	
1507	26.90	α-agarofurane	1.77			-	-
1509	26.91	acorenone		2.10		-	-
1564	28.17	nerolidol	8.41	29.69	17,26%	17.4	23,0
1631	29.84	eremoligenol (eremophil-1(10)-en-11-ol	2.05	2.52		-	-
1651	30.43	β-eudesmol	25.71	28.59	42,25%	52.7	34,9
1718	31.60	(Z,Z)-farnesol		8.28		-	-
1763	32.82	lanceol		0.82			

1: aerial parts. 2: aerial parts. 3: aerial parts

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CONCLUSION

In conclusion, we report for the first time the comparative study of the chemical composition of the essential oils of the leaves and the flowers of *Warionia saharae* which were different. Our results were different from the few reports, performed on the essential oil of the whole aerial parts of Morroco samples of this species and showed that the Algerian sample contained higher proportions of linalool and (E)-nerolidol and relatively less proportion of β-eudesmol. It was also found that the other main constituents: 1,8- cineol, nerol, α-terpineol and β-caryophyllene were present in higher proportions in the Algerian sample and (*Z,Z*)-farnesol, eremoligenol and acorenone were described for the first time in the oil of *Warionia saharae.*

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