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CHEMICAL COMPOSITION AND CONTENT OF ESSENTIAL OIL OF *Lavandula multifida* FROM ALGERIA

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The genus *Lavandula* of the Labiatiae (syn. Lamiacea) family consists of about 30–32 species, distributed from the North Atlantic Islands (Macaronesia) to the Mediterranean Basin, North Africa, the Middle East, tropical NE Africa, and India regions [1]. *Lavandula* species are mainly grown for their essential oils, which are used in perfumery, cosmetics, food processing, and nowadays also in "aromatherapy" products [2]. Lavender essential oil is used to treat depression, diabetes, epilepsy, headaches, and for their sedative properties and anti-inflammatory, antimicrobial, antifungal, and antioxidant activities [3–5].

Lavandula multifida L. is a perennial with a woody base up to 40 cm, native to South Spain, Italy (Southern tip only), and North Africa (Morocco, Algeria, Tunisia, and Libya) often associated with open disturbed areas and areas of habitation [2]. The leaves and stems of this species are used in Moroccan folk medicine to prepare decoctions against rheumatism and chill and as a digestive system beneficial agent [6]. Some studies have revealed the anti-inflammatory, antimicrobial, and antifungal activities of the essential oil of *L. multifida* [7–9]. Also, *L. multifida* oil acts as good corrosion inhibitor for steel in 0.5 M H_2SO_4 [10].

The present paper deals with the chemical composition of the essential oil of *L. multifida* growing wild in northern Algeria. According to the results of our literature search, no study has been conducted in Algeria on the chemical composition of the essential oil of *L. multifida* species.The objective of this study was to determine the content and composition of the essential oil isolated from inflorescences and leaves of *L. multifida* in order to evaluate its potential use as a source of aroma chemicals.

The chemical compositions of the essential oils obtained by steam distillation from inflorescences and leaves of *Lavandula multifida* are listed in Table 1. In this study, a total of 29 and 43 compounds (92 and 96.25%) were identified in the inflorescence and leaf oils, respectively. The dominant constituents in the inflorescence oils were carvacrol (61.73%), linalool (5.69%), and 1-octen-3-ol (3%). The major components in the leaf oils were carvacrol (50.92%) followed by anethole (17.37%), β-bisabolene (5.81%), linalool (3.42%), and minor percentages of others. The monoterpene hydrocarbons in both samples were found to be very low (1.84% in inflorescences and 1.47% in leaves). The oxygenated monoterpenes were found to be high in both oils (74.68% in inflorescence and 58.25% in leaf oils). The result showed that carvacrol is the most abundant monoterpene with 61.73% and 50.92% in inflorescences and leaves, respectively. The total contents of sesquiterpene compounds (hydrocarbons and oxygenated) constitute 3.46% (inflorescences) and 8.61% (leaves). The other compounds constitute 12.02% (inflorescences) and 27.92% (leaves), with a high percentage of anethole (17.37%) in the leaf oils none in the inflorescence oils. These results were in accord with those previously reported in the literature. In fact, some studies have shown that carvacrol is the main component [2, 8–11]. The essential oil of *L. multifida* from Tunisia was found to be rich in carvacrol (31.81%), β-bisabolene (14.89%), and acrylic acid dodecyl ester (11.43%). Also, a recent study on the chemical composition of essential oil from Marocco plants showed the presence of carvacrol (57.9–59%), carvacrol methyl ether (7–7.6%), and *p*-cymen-8-ol (3.9–4.7%). The main components of *L. multifida* oil from Portugal were carvacrol (42.8–41.5%), *cis*-β-ocimene (27.4–27%), β-bisabolene (5–5.6%), and myrcene (5.5–5.7%).

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TABLE 1. Composition of the Essential Oil from Inflorescences and Leaves of *Lavandula multifida*, %

Compound*	RI	I	L	Compound*	RI	I	L
Furfural	825	0.52	0.56	Anethole	1290	–	17.37
2-Furan methanol	843	–	0.13	Carvacrol	1301	61.73	50.92
3-Hexen-1-ol, (*Z*)-	846	–	0.60	Cyclohexene, 2-ethenyl-1,3,3-trimethyl-	1303	0.55	–
Benzaldehyde	957	0.52	0.57				
1-Octen-3-ol	973	3	0.30	*p*-Menth-1-en-9-ol	1307	–	0.50
β-Myrcene	983	0.27	0.37	2-Methoxy-4-vinylphenol	1310	1.24	1.49
β-Ocimene (*Z*)	1029	0.74	0.63	Eugenol	1349	0.34	0.27
1-Octanol	1063	–	0.14	*cis*-Geranyl acetate	1354	0.36	–
cis-Linalool oxide	1064	–	0.23	*β*-Damascenone	1375	–	0.35
α-Terpinolene	1079	0.83	0.47	Caryophyllene	1417	0.90	1.24
4-Vinyl-*o*-xylene	1084	–	0.26	*cis*-(–)-2,4a,5,6,9a Hexahydro-3,5,5,9-tetramethyl (1*H*) benzocycloheptene	1479	–	1.07
L-Linalool	1094	5.69	3.42				
Phenylethyl alcohol	1105	–	0.29	Germacrene-D	1495	–	0.18
exo-Fenchol	1114	0.99	0.24	*β*-Bisabolene	1506	1	5.81
Terpinen-4-ol	1175	0.55	0.19	Cubinene	1518	–	0.19
Phenol, 2,3,5,6-tetramethyl	1181	0.84	0.65	Elemicin	1542	0.35	–
α-Terpineol	1189	2.29	0.69	Caryophyllene oxide	1582	0.64	0.36
Cyclohexene, 1-methyl-3-(1-methylethenyl)-, (+/–)-	1192	–	0.81	Epizonarene	1595	0.57	0.60
				Tributyl phosphate	1639	–	0.12
Benzofuran, 2,3-dihydro-	1208	1.26	0.58	*α*-Bisabolol	1684	–	0.23
p-Menth-1-en-9-al	1213	0.53	0.52	Tetradecanoic acid	1756	0.40	0.22
6-Methyl-3-cyclohexene-1-carboxaldehyde	1215	0.64	–	*n*-Hexadecanoic acid	1957	0.61	0.30
				9-Octadecenamide, (*Z*)-	2390	2.03	0.81
Bicyclo[3.2.2]non-8-en-6-ol, (1*R*,5-*cis*,6-*cis*)-	1215	–	0.61	Monoterpene hydrocarbons		1.84	1.47
				Oxygenated monoterpenes		74.68	58.25
cis-Geraniol	1223	0.74	0.21	Sesquiterpene hydrocarbons		2.82	8.02
Benzene, 1-methoxy-4-methyl-2-(1-methylethyl)-	1234	–	0.70	Oxygenated sesquiterpenes		0.64	0.59
				Other compounds		12.02	27.92
Propanal, 2-methyl-3-phenyl	1241	–	0.34	Total percentage		92	96.25
Geraniol	1252	1.46	0.71				

RI: Relative retention indices to C8–C24 *n*-alkanes on HP-MS column; *compounds listed in order of elution from HP-5MS column; %: area percent; I: inflorescences; L: leaves.

Comparison of our results with the literature data shows that the predominance of carvacrol in our sample was in accord with those reported in the literature [8, 11]. Bisabolene is another major component often encountered in the chemical composition of essential oils of *L. multifida*. The other compounds and their percentage were different. According to Lis-Balchin [2], *L. multifida* is unique in producing large amounts of carvacrol and bisabolene. For the first time, anethole has been identified as the predominant compound in the composition of the essential oil extracted from the leaf of *Lavandula multifida.*

Plant Material and Isolation Procedure. The inflorescences and leaves of *Lavandula multifida* L. were collected in the second week of April 2012 in the station called Sidi-Ameur within the region of Chlef located in northern Algeria. A voucher specimen has been deposited in the Botanic department of the Agronomic Institute of the Hassiba Benbouali University of Chlef. Air-dried samples and inflorescences (350 g) were submitted to steam distillation for 2 hours at 100°C (the pressure was fixed at 1200 hPa). The water vapor with the volatile constituents was condensed and decanted at 20°C. The extractions afforded pale yellow oils with a very strong and persistent lavender flavor. Three replicates of each plant part were carried out. The yield of oil (w/w) was 1% and 0.8% for inflorescences and leaves, respectively.

Identification of the Oil Components. The analyses of the essential oil were performed by GC-FID and GC-MS.

GC-FID Analysis. Gas chromatography analyses were carried out on a Hewlett-Packard Agilent 6890 N, using a capillary column (HP-5MS) coated with 5% phenylmethylsiloxane (30 m × 0.25 mm × 0.25 μm film thickness). The thermostat temperature was 50°C with programming at 4°C/min to 250°C. The injector temperature was 250°C, and the detector temperature was 300°C. The injected volume was 0.5 μL, and the split ratio was 1:50. The carrier gas was helium, 1 mL/min.

GC/MS Analysis. GC/MS was conducted using an Agilent 5973 GC/MS coupled to an Agilent 6890N gas chromatograph fitted with a split-splitless injector at 250°C (Splitless mode). Analytical conditions were fixed as follows: Agilent HP-5MS capillary column (30 m × 0.25 mm, df = 0.25 μm); temperature program from 50–250°C at 4°C/min; mobile phase He at 1 mL/min. Mass spectra were recorded in the EI mode (70 ev), scanned mass range 35 to 500 amu. Source and quadrupole temperatures were fixed at 230°C and 150°C, respectively. The identification of the components was performed on the basis of chromatographic retention indices and by comparison of the recorded spectra with computed data libraries [12]. Further confirmations were obtained by comparing the mass spectra with data from the literature [13].

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