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A Myristicin-rich Essential Oil from *Daucus sahariensis* Growing in Algeria

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The essential oils obtained by hydrodistillation from leaves and fruits of *Daucus sahariensis* Murb. were analyzed by GC/MS. The main constituents of the essential oil from the leaves were myristicin (34.3%), α-pinene (5.4%), *cis*-chrysanthenyl acetate (5.3%) and *epi*-α-bisabolol (4.8%), and those from the fruits myristicin (43.9%), α-pinene (13.1%), limonene (9.4%), and *cis*-chrysanthenyl acetate (7.4%). Myristicin, the main constituent of both essential oils, is generally absent in the oils from other *Daucus* species, permitting the hypothesis that this compound is a chemical marker of this Saharan species.

Keywords: *Daucus sahariensis*, Apiaceae, essential oil, leaves, fruits, myristicin.

For a long time, plants from the Apiaceae family have been used as spices and drugs, mainly because of their essential oils [1]. *Daucus* is a genus of the family Apiaceae (Umbelliferae), which includes about 60 species [2], most of which grow in Europe, Africa, West Asia and North America [3]. In Algeria eleven species of *Daucus* can be found [4]. Two of them, *D. sahariensis* Murb. and *D. biseriatus* Murb, grow in the Saharan territory [5]. *Daucus* species have been intensively studied mainly for their flavonoid and essential oil contents [6]. It was observed to be the richest genus of the Apiaceae in essential oil. The composition of the essential oils was found very useful for the chemotaxonomic separation and characterization of the genus within the family [7,8]. Most papers have dealt with *D. carota* and its subspecies [3]. Besides its nutritional value, the fleshy edible roots of *D. carota* also contain aromatic compounds. They have been used since ancient times in traditional medicine for the antibacterial and antifungal properties of their essential oils (carrot oil) [1,9,10]. Furthermore, other medicinal properties have been ascribed to plants of this genus, for example, diuretic, hypotensive, carminative, antilipemic and stomachic [11-13]. The essential oil of carrot seeds is widely used as a flavor ingredient in most of the major food categories and as a fragrance component in perfumes, soaps and cosmetics [14a,b].

D. sahariensis Murb. is a small, hairy, annual herb that grows in desert pasture, especially in the pre-Saharan region and the Septentrional Sahara, with leaves turning yellow as it dries. The fruits have very regular, golden or tawny spines. In Algeria the species can be found in Tindouf and Mzab [4,5,15].

This paper is the first study of the composition of the essential oil obtained from the leaves and fruits of *D. sahariensis* growing in Algeria.

The composition of the essential oils of the leaves and fruits are reported in Table 1. Altogether, 97 compounds were identified in the two samples. In the leaf oil, 80 compounds were detected, representing 91.3% of the whole oil. The essential oil (yield 0.02%, w/w) was mainly composed of phenylpropanoids (37.1%), with myristicin (34.3%) as the major constituent. This is contained in many essential oils, but in quite low amounts. Sometimes it is a major constituent, such as in the essential oil of *Clausena indica* [16]. Other important classes of chemicals were monoterpene hydrocarbons (18.7%), oxygenated monoterpenes (16.0%), oxygenated sesquiterpenes (11.5%), and sesquiterpene hydrocarbons (5.7%). Furthermore, some non-terpene compounds were also detected (2.3%).The main constituent of the essential oil from the leaves was myristicin (34.3%), followed by α-pinene (5.4%), *cis*-chrysanthenyl acetate (5.3%) and *epi*-α-bisabolol (4.8%).

The fruits yielded 0.54% of essential oil, in which 77 compounds were identified, accounting for 98.9% of the whole oil. The essential oil of the fruits was mostly

Table 1: Percentage composition of the essential oils of the leaves and fruits of *Daucus sahariensis* from Algeria.

Constituents	l.r.i.[a]	fruits	leaves
(E)-2-Hexenal	856	tr	0.1
2-Heptanone	891	-	tr
Heptanal	900	tr	0.3
Tricyclene	928	-	tr
α-Thujene	931	tr	tr
α-Pinene	939	13.1	5.4
Camphene	953	0.9	0.7
Thuja-2,4(10)-diene	957	tr	0.2
Benzaldehyde	961	tr	tr
Heptanol	969	-	tr
Sabinene	976	2.0	0.9
β-Pinene	980	1.8	0.4
6-Methyl-5-hepten-2-one	985	tr	0.1
3-Octanone	988	-	tr
Myrcene	991	5.7	4.5
Octanal	1002	tr	tr
α-Phellandrene	1005	tr	tr
α-Terpinene	1018	0.2	0.3
p-Cymene	1027	0.5	0.7
Limonene	1031	9.4	3.9
1,8-Cineole	1035	tr	-
(Z)-β-Ocimene	1041	0.8	0.4
Phenyl acetaldehyde	1045	tr	0.2
(E)-β-Ocimene	1051	0.2	tr
γ-Terpinene	1062	1.2	0.5
cis-Sabinene hydrate	1070	tr	tr
Terpinolene	1089	0.3	-
p-Cymenene	1090	-	0.8
2-Nonanone	1091	-	tr
Perillene	1099	0.3	0.9
Linalool	1100	-	tr
Nonanal	1103	tr	0.3
1,3,8-*p*-Menthatriene	1112	tr	tr
cis-*p*-Menth-2-en-1-ol	1123	0.1	0.4
α-Campholenal	1127	-	0.2
Alloocimene	1129	tr	-
cis-Limonene oxide	1135	tr	-
cis-*p*-Mentha-2,8-dien-1-ol	1139	tr	tr
trans-Sabinol	1140	-	0.2
trans-Pinocarveol	1141	0.1	0.4
cis-Verbenol	1142	0.4	0.9
trans-Verbenol	1144	-	tr
β-Pinene oxide	1158	-	tr
(E)-2-Nonenal	1160	tr	0.7
cis-Chrysanthenol	1161	1.2	0.4
Isoborneol	1162	tr	-
p-Menth-1,5-dien-8-ol	1166	tr	0.5
Terpinen-4-ol	1178	0.4	0.9
p-Cymen-8-ol	1185	0.2	0.8
Cryptone	1186	tr	-
trans-*p*-Mentha-1(7),8-dien-2-ol	1190	tr	-
α-Terpineol	1192	0.2	0.3
Myrtenal	1194	tr	tr
Methyl chavicol	1197	0.5	2.0
Decanal	1205	tr	0.2
Verbenone	1207	0.2	0.2
trans-Carveol	1219	0.1	0.2
cis-Carveol	1231	tr	-
carvone	1244	tr	0.2
cis-Chrysanthenyl acetate	1263	7.4	5.3
Isobornyl acetate	1286	1.7	4.2
trans-Pinocarvyl acetate	1299	tr	-
Carvacrol	1300	tr	-
trans-Carvyl acetate	1339	tr	-
α-Cubebene	1351	tr	-
α-Copaene	1376	-	0.3
(E)-β-Damascenone	1382	-	0.2
B-C ubebene	1290	tr	0.2
β-Elemene	1391	tr	-
Methyl eugenol	1403	0.2	0.2
β-Caryophyllene	1418	0.3	0.5
trans-α-Bergamotene	1439	tr	0.1
α-Humulene	1455	3.2	2.0
trans-Cadina-1(6),4-diene	1470	-	tr
γ-Muurolene	1477	tr	-
Germacrene D	1480	0.5	1.9
Bicyclogermacrene	1494	0.3	0.3
α-Muurolene	1500	-	tr
trans-β-Guaiene	1503	tr	-
β-Bisabolene	1509	0.1	0.2
trans-γ-Cadinene	1513	tr	0.1
Myristicin	1520	**43.9**	**34.3**
α-Calacorene	1542	-	0.1
Elemicin	1554	0.3	0.2
(Z)-3-Hexenyl benzoate	1570	tr	0.2
Spathulenol	1576	0.4	1.0
Caryophyllene oxide	1581	tr	0.6
β-Oplopenone	1606	-	0.2
Humulene oxide II	1607	0.3	1.9
α-Acorenol	1632	-	0.3
T-Cadinol	1641	tr	0.3
β-Eudesmol	1649	0.1	2.2
α-Cadinol	1654	0.2	-
Apiole	1678	-	0.4
epi-α-Bisabolol	1686	0.3	4.8
Hexahydrofarnesylacetone	1845	-	0.2
Monoterpene hydrocarbons		36.1	18.7
Oxygenated monoterpenes		12.2	16.0
Sesquiterpene hydrocarbons		4.4	5.7
Oxygenated sesquiterpenes		1.3	11.5
Phenylpropanoids		44.9	37.1
Non-terpene derivatives		tr	2.3
Total identified (%)		98.9	91.3
Number of compounds		77	80
Essential oil yield (%, w/w)		0.54	0.02

l.r.i.[a]= Linear retention indices (HP-5 column).
tr = trace(< 0.1%).
- = not detected.

constituted of phenylpropanoids (44.9%), mainly because of the high percentage of myristicin (43.9%), followed by monoterpene hydrocarbons (36.1%), largely represented by α-pinene (13.1%), limonene (9.4%) and myrcene (5.7%). Another important class of volatiles was oxygenated monoterpenes (12.2%), mainly represented by *cis*-chrysanthenyl acetate (7.4%). Sesquiterpene hydrocarbons and oxygenated sesquiterpenes were less represented (4.4% and 1.3%, respectively). Non-terpene derivatives were detected only in traces amounts. The main constituents identified in the essential oil of the fruits were myristicin (43.9%), α-pinene (13.1%), limonene (9.4%) and *cis*-chrysanthenyl acetate (7.4%).

Concerning the chemical composition of the essential oil of other *Daucus* species, Flamini *et al*. [11] showed that the leaves and fruits oils of *D. gingidium* ssp. *gingidium* growing in Italy were dominated by sabinene (26.8-60.6%) and α-pinene (10.8-12.2%). In the aerial parts of *D. reboudii,* an endemic species of Algeria, Djarri *et al*. [3] also found α-pinene (39.7%) and sabinene (21.2%) as the main constituents. Mockute and Nivinskiene [17] also reported that the essential oil of the fruits of different samples of *D. carota* ssp. *carota* collected in Lithuania was characterized by high contents of sabinene and α-pinene. Similar results have been found by Góra *et al*. [18] and Staniszewska *et al* [10].

In the case of *D. carota* ssp. *gummifer*, high percentages of geranyl acetate have been reported [19]. Wu *et al*. [20] identified carotol and α-pinene as the major components of the oil from *D. carota* subsp. *sativus* from China. In the fruits of the same subspecies and in another *D. carota* (subspecies not reported) the main constituents were carotol, and daucol [21-23]. In the essential oil obtained from *D. carota* ssp. *maximus*, *trans*-methyl isoeugenol and β-bisabolene were identified as the main volatiles of the fruits, while preisocalamendiol and shyobunone were the main ones of the leaves [6]. However, Radulović *et al*. [24] reported the presence of myristicin (15.4%) in the volatile constituents of the aerial parts of *D. guttatus* ssp *zahariadii* growing wild in Serbia.

Hence, the composition of the essential oil of the leaves and fruits of *D. sahariensis* was very different from that of all the *Daucus* species studied so far. The compound that mostly characterized this species was myristicin.

Experimental

Plant material and isolation: The leaves of *Daucus sahariensis* were collected during February 2009 near Bousaada M'sila (pre-Saharan area) on a sandy soil, approximately 250 km south-east of Algiers, Algeria. The fruits were collected during the ripening stage at the end of April 2009 from the same place. Fresh leaves and fruits were dried to constant weight at room temperature. The plants were identified by Dr Zellagui Amar and a voucher sample was deposited in the Laboratory of Biomolecules and Plant Breeding, University of Larbi Ben Mhidi Oum El Bouaghi, Algeria (*Daucus sahariensis* voucher number ZA 114). The dried plant material (200 and 150 g for leaves and fruits, respectively) were hydrodistilled in a Clevenger-type apparatus for 2 h.

Gas chromatography – mass spectrometry: GC-MS analyses were performed with a Varian CP-3800 gas-chromatograph equipped with a DB-5 capillary column (30 m × 0.25 mm; coating thickness 0.25 µm) and a Varian Saturn 2000 ion trap mass detector. Analytical conditions: injector and transfer line temperatures 220 and 240°C, respectively; oven temperature programmed from 60°C to 240°C at 3°C/min; carrier gas helium at 1 mL/min; injection 0.2 µL (10% *n*-hexane solution); split ratio 1:30. Identification of the constituents was based on comparison of the retention times with those of authentic samples, comparing their linear retention indices relative to the series of *n*-hydrocarbons, and by computer matching against commercial (NIST 98 and ADAMS) and homemade library mass spectra built up from pure substances and components of known oils and MS literature data [25].

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