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Chemical composition of the essential oil of *Brachyapium dichotomum* (L.) Maire

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ABSTRACT

The essential oil obtained by hydrodistillation from the aerial parts of Brachyapium dichotomum (L.) Maire (Apiaceae), was analyzed by GC-MS for the first time. Sixty-two compounds were detected, accounting for 96.1% of the total oil, which is characterized by a high content of hydrocarbons derivatives of mono- and sesquiterpenes (80.3%). The main constituents were α-pinene (36.5%), germacrene D (17.9%), dill apiole (6.7%) and myristicin (3.5%).

Keywords: *Brachyapium dichotomum,* Apiaceae, Essential oil, GC-MS, α-pinene

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INTRODUCTION

The family Apiaceae, or carrot family, is one of the most widely studied families of flowering plants, comprising about 450 genera with 3540 species [1,2].This large family is a well known producer of essential oil endowed with therapeutic properties, namely antibacterial, antioxidant and antifungal activities, therefore it is used as natural preservatives for food products [3,4]. Belonging to this family, *Brachyapium*, subfamily Apioideae, is represented by three species: *B. dichotomum*, distributed in North Africa and in the Western Mediterranean basin, especially in Spain [5,6], *B.pomelianum*, endemic of Algeria [7] and *B. hanotei*, which can be found only in Morocco [8].

According to the Flora of Algeria [7], the genus *Brachyapium* is constituted by two species: *B. dichotomum* (L.) Maire and *B. pomelianum* Maire. *B. dichotomum* (L.) Maire (syn. = *Stoibrax dichotoma* (L.) Rafin.L.) [5,9,10,11] is a small, annual herb that grows in mountain forests, dichotomous and branched from the base, with a celery odor and white flowers. The fruit is very small, about 1 mm, globular with hispid short capitates hairs [7].

To the best of our knowledge, there are no previous phytochemical reports concerning the whole *Brachyapium* genus. Therefore, the present investigation is reporting for the first time the composition of the essential oil obtained from *Brachyapium dichotomum* growing wild in Algeria.

MATERIALS AND METHODS

Plant material

The aerial parts of *B. dichotomum* were collected in May 2011 at M'sila (Algeria). Plants were identified by Dr Errol Vela, University of Montpellier 2 (French) and a voucher sample was deposited at the ddepartment of natural and life sciences, faculty of sciences, Mohamed Boudiaf University of M'sila, Algeria, plate number (ST/RK N°01) (Fig 1).

Figure 1: *Brachyapium dichotomum* (L.) Maire of M'sila (Photo: K. Rebbas, 20.7.2015)

Essential oil extraction

The dried plant material (200 g) was coarsely cut and hydrodistilled in a Clevenger-type apparatus for 2 h.

Chemical analysis

Gas chromatography – mass spectrometry analyses were performed with a Varian CP-3800 gas chromatograph equipped with a DB-5 capillary column (30m × 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 to240°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 volatile components

The identification of the volatile 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 [12] and homemade library mass spectra built up from pure substances and components of known oils and MS literature data [12,13,14,15,16,17].

RESULTS AND DISCUSSION

The yield of the essential oil obtained from the aerial parts of *B. dichotomum* was 0.06% (w/w) and its composition is reported in Table 1. Sixty two compounds were characterized, representing 96.1% of the whole oil. The essential oil was mainly composed by monoterpene (50.1%), with hydrocarbon derivatives (48%) as the major group. Quite high amounts of α-pinene (36.5%) were detected. Oxygenated monoterpenes were found in lower percentages (2.1%), while sesquiterpenes (34.5%) constituted the second most abundant chemical class, largely represented by hydrocarbon derivatives (32.3%), with germacrene D (17.9%) as the major constituent. Oxygenated sesquiterpenes accounted for only 2.1%. Phenylpropanoids (11.6%) were another important class of volatiles in *B. dichotomum* essential oil. They were mainly represented by dill apiole (6.6%) and myristicin (3.5%). Trace amounts of non-terpene derivatives were also detected (Table 1).

Table 1: composition (%) of the essential oils of the aerial parts of *Brachyapium dichotomum* growing in Algeria		
Compound name	**RI[a]**	**Content(%)[b]**
α-Thujene	931	tr[c]
α-Pinene	939	36.4
Camphene	954	0.4
Sabinene	977	0.7
β-Pinene	980	3.5
Myrcene	992	2.4
Octanal	1002	tr
α-Terpinene	1018	tr
p-Cymene	1027	0.6
Limonene	1031	1.1
1,8-Cineole	1034	0.3
(Z)-β-Ocimene	1041	tr
(E)-β-Ocimene	1051	tr
γ-Terpinene	1062	2.9
cis-Sabinene hydrate	1070	tr
Terpinolene	1089	tr
Linalool	1100	0.3
Nonanal	1103	tr
cis-p-Menth-2-en-1-ol	1123	tr
cis-Verbenol	1142	tr
4-Terpineol	1178	tr
α-Terpineol	1190	tr
Methyl thymol ether	1135	tr
Methyl carvacrol ether	1244	tr
cis-Chrysanthenyl acetate	1263	tr
Thymol	1291	1.5
α-Cubebene	1351	0.5
α-Copaene	1376	0.9
β-Bourbonene	1384	0.8
β-Cubebene	1390	1.7
β-Elemene	1392	tr
Methyl eugenol	1403	tr
Dodecanal	1407	tr
β-Caryophyllene	1418	0.5
β-Gurjunene	1432	0.2
Aromadendrene	1440	0.2
α-Humulene	1455	0.3
(E)-β-Farnesene	1459	tr
Alloaromadendrene	1461	0.1
cis-Muurola-4(14),5-diene	1463	tr
γ-Muurolene	1477	tr
Germacrene D	1480	17.9
trans-Muurola-4(14),5-diene	1492	tr
Bicyclogermacrene	1494	3.2
Epizonarene	1497	tr
α-Bulnesene	1505	0.2
β-Bisabolene	1509	4.3
trans-γ-Cadinene	1513	0.3
Myristicin	1520	3.5
δ-Cadinene	1524	1.2
Elemicin	1554	tr
Spathulenol	1576	0.8
Globulol	1583	0.2
Gleenol	1585	0.2
Isoaromadendrene epoxide	1595	0.1
Humulene oxide II	1606	0.1
1,10-di-*epi*-Cubenol	1614	tr
Dill apiole	1622	6.6
α-Acorenol	1631	tr
T-Cadinol	1641	0.3
α-Cadinol	1654	0.4
Apiole	1680	1.5
Essential oils Yield (%, w/w)		0.06
Number of compounds		62
Class		
Monoterpene hydrocarbons		48.0
Oxygenated monoterpenes		2.1
Sesquiterpene hydrocarbons		32.3

Oxygenated sesquiterpenes		2.1
Phenylpropanoids		11.6
Non-terpene derivatives		tr
Total		**96.1**

[a] Retention index (RI) determined relatively to the retention time of a series of n-alkanes
[b] Content (%): Relative percentage calculated by GC/MS on an apolar capillary column HP-5
[c] tr: traces (<0.1%)

In the literature**,** α-pinene which is the principal constituent in the volatile oils of *B. dichotomum* in our analyses is a common compound of the essential oils of several species of Apiaceae, such as *Elaeoselinum asclepium* subsp. *meoides* (60.8-92.2%) [18].

On otherhand, it has been hypothesized that a *Carum* species, *C. pimpinelloides* from the Socotran Archipelago, could be closely correlated to *B.dichotomum* [19]. Chemical data could help to verify its correct placement within the *Carum* genus. In fact, in *C.carvi* the main constituents of the essential oil are limonene (7.6-18.2%) and carvone (23.3-86.4%) [20,21,22], sometimes together with other compounds such as *trans*-dihydrocarvone (14.0%), carvacrol (6.7%) and β–caryophyllene (6.1%) [23]. *Carum copticum* has thymol (54.5-64.5%) as main constituent, together with its biosynthetic precursors γ-terpinene (13.8-23.0%) and *p*-cymene (16.2-21.4%) [24,25,26]. Other *Carum* species produce very high percentages of phenylpropanoids. This is the case of *C. montanum* and *C. nigrum*, with nothoapiole (62.8 and 5.8%, respectively) and dill apiole (8.5 and 29.9%) [27,28]. Unfortunately, at present no data are available for *C. pimpinelloides*.

CONCLUSION

This is the first report on secondary metabolites of the *Brachyapium* genus. The study of the essential oil of *Brachyapium dichotomum* permitted us to identify 62 compounds. The plant biosynthesizes different chemical classes, mainly monoterpenes, sesquiterpenes and phenylpropanoids. The essential oil was characterized by a high content of monoterpene hydrocarbons, in particular α-pinene. Therefore, it is evident that the essential oil chemistry of this plant is quite different from that of the *Carum* genus.

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