Chemical Constituents of Essential Oil and Hydrosol Extract from *Teucrium kabylicum* Batt., an Endemic Species from Algeria

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Summary

The main objective of this study was to determine for the first time the chemical composition of the essential oil and hydrosol extract of *Teucrium kabylicum* Batt growing in south Algeria. In this study, the aerial parts of the plant were hydrodistilled in a Clevenger-type apparatus. The isolated essential oil and hydrosol extract were analyzed using gas chromatography (GC) and gas chromatography-mass spectrometry (GC/MS). The essential oil of *T. kabylicum* was principally characterized by monoterpene hydrocarbons compounds represented by limonene (23.5%) and terpinolene (19.5%), followed by aliphatic compounds represented by hexanol (26.5%). The major compounds of hydrosol extract were terpinene-4-ol (23.5%), limonene, 1-2-epoxide (15.6%), citronellal (13.6%), caryophyllene oxide (8.6%), geraniol (5.6%) and spathulenol (3.6%). The essential oil of *T. kabylicum* was principally characterized by monoterpene hydrocarbons and aliphatic compounds, while hydrosol extract was characterized by oxygenated components only.

Key words

Teucrium kabylicum, essential oils, hydrosol extract, GC/MS

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Introduction

The genus *Teucrium* belongs to Lamiaceae (Labiatae) family and includes approximately 300 species widespread around the world, distributed mainly in the Mediterranean region [Carović-Stanko et al., 2016]. In many countries, different *Teucrium* species have been widely used to treat several ailments, especially against stomach and intestinal problems. Additionally, they are used in traditional medicine as antipyretic, diuretic, diaphoretic, antispasmodic, antiseptic, antidiabetic and as sedative agents [Hasani-Ranjbar et al., 2010; Aksoy-Sagirli et al., 2015]. Several works have been carried out on the genus *Teucrium* essential oils, in particular on the species of *Teucrium flavum* L. subsp. *hellenicum* Rech.f., *Teucrium creticum* L., *Teucrium marum* L., *Teucrium massiliense* L., *Teucrium chamaedrys* L., *Teucrium scorodonia* L. subsp. *scorodonia* and *Teucrium polium* L. subsp. *capitatum* [Baser et al., 1997; Valentini et al., 1997; Bellomaria et al, 1998; Djabou et al., 2013]. It turned out that these essential oils were found to be rich in sesquiterpenoids. To our best knowledge, there are no results on the chemical composition of essential oils and of the hydrosol extract of *T. kabylicum*. Therefore, the aim of this research was to study for the first time the essential oil and hydrosol extract composition of aerial parts of *T. kabylicum*.

Materials and methods

Aerial parts of *T. kabylicum* (15 - 20 cm size) were harvested from Annaba (Algeria) in September 2014. The sample was identified by Dr. Hamel Tarek and Dr. De Bélaire Gérard, University of Badji Mokhtar-Annaba, Algeria and a voucher specimen (No. Tk-2014) was deposited in the Herbarium of the Laboratory "*Laboratoire des substances naturelles et bioactives*", Tlemcen University, Algeria. Essential oil was obtained from fresh aerial parts by hydrodistillation for 5 h, yielding 0.4% of yellow essential oil. During the distillation, the first 500 mL of water from hydrodistillation was recovered and extracted three times with 200 mL of diethyl ether at room temperature to get the hydrosol extract with yield of 0.02%.

Gas chromatographic analyses were performed in a Hewlett Packard 6890 chromatograph equipped with a non-polar column HP5MS (30 × 0.25 mm i. d., film thickness 0.25 μm) and a flame ionization detector. The conditions were as follows: carrier gas, nitrogen; flow rate, 0.8 $mL.min^{-1}$; injector temperature, 250°C; detectors temperature, 300°C; temperature program, from 60 to 250 at 2°C min^{-1}, with two levels, 8 min at 60°C and 15 min at 280°C; injection of 0.4 μL of pure essential oil and 1 μL of absolute mode, mode split 1:20. To determine retentions indices (RI), a serie of n-alkanes (C_5–C_{28}) mixture was analyzed under the same operative conditions on HP-5 columns and the sample indices were calculated.

Essential oil and hydrosol extract were analyzed on GC-MS (Hewlet Packard 5973A, equipped with an apolar capillary column HP5MS, 30 m × 0.25 mm, phase thickness: 0.25 μm); detection mode, electronic impact; ionization current, 70 eV; carrier gas, helium; flow rate, 0.7 $mL.min^{-1}$; source pressure, 10.7 mbar; interface temperature, 280°C; injection, 250°C; programming of the oven: 2°C min^{-1} from 60 to 280°C, with 8 min isothermal at 60°C and 15 min isothermal at 280°C; 0.1 - 0.2 μL of pure essential oil and 1 μL hydrosol extract were injected in split mode, 1:20. Identification was confirmed by comparison of their mass spectral fragmentation patterns with those stored in the MS database (National Institute of Standards and Technology and Wiley Libraries).

Results and Discussion

Twenty-five components accounting for 94.6% were identified in the essential oil (Table 1). The major classes of components were the monoterpene hydrocarbons with a percentage of 50.3%, followed by aliphatic compounds (27.4%) and sesquiterpene hydrocarbons (10.2%) (Table 1).

Table 1. Chemical composition of essential oil and hydrosol extract of *Teucrium kabylicum*

N°	Constituent	RI[a]	EO[b]	HE[c]	Identification
1	Heptane	699	0.9	-	GC/MS
2	Hexanol	835	26.5	12.5	GC/MS
3	α-Fenchene	948	3.4	-	GC/MS
4	Sabinene	573	0.8	-	GC/MS
5	β-Pinene	964	0.4	-	GC/MS
6	Myrcene	981	0.3	-	GC/MS
7	α-Phellandrene	1005	0.7	-	GC/MS
8	Limonene	1044	23.5	-	GC/MS
9	E-β-Ocimene	1054	1.2	-	GC/MS
10	γ-Terpinene	1063	0.5	-	GC/MS
11	Terpinolene	1088	19.5	-	GC/MS
12	Limonene 1-2-epoxide	1117	0.1	15.6	GC/MS
13	Citronellal	1168	0.1	13.6	GC/MS
14	Terpinene-4-ol	1177	0.4	23.5	GC/MS
15	β-Caryophyllene	1430	8.7	-	GC/MS
16	E-β-Farnesene	1445	0.5	-	GC/MS
17	α-Humulene	1450	0.3	-	GC/MS
18	Germacrene D	1498	0.7	-	GC/MS
19	Geraniol	1530	1.2	5.6	GC/MS
20	Trans sesquisabinene hydrate	1576	0.1	0.6	GC/MS
21	Caryophyllene oxide	1585	1.1	8.6	GC/MS
22	Spathulenol	1596	0.2	3.6	GC/MS
23	tau-Cadinol	1615	0.1	0.8	GC/MS
24	tau-Muurorol	1642	1.2	-	GC/MS
25	Phytol	2065	2.2	5.6	GC/MS
	% Total identification		94.6	90.0	

[a] RI: retention indices; [b] EO: Essential Oil; [c] HE: Hydrosol Extract

Among the monoterpene hydrocarbons, limonene (23.5%) and terpinolene (19.5%) were the main constituents. Aliphatic compounds were dominated by hexanol (26.5%). Sesquiterpene hydrocarbons were dominated by β-carryophyllene (14.2%) and oxygenated diterpenes by phytol (2.2%) (Table 1). Predominant compounds of the essential oils obtained from many *Teucrium* species by hydrodistillation are sesquiterpenoids. Indeed, the main constituents of *T. arduini* L. oil were: β-caryophyllene (24.5%) and germacrene D (21.9%). The oil of *T. botrys* L. was characterized by β-caryophyllene (20.4%), (E)- β-farnesene (17.7%), α-humulene (13.9%), α-pinene (8.1%) and β-pinene (7.9%). The herb of *T. chamaedys* L. contained β-caryophyllene (26.9%) and germacrene D (22.8%). *T. flavum* L. oil was characterized by β-bisabolene (35.0%), α-pinene (17.5%) and β-pinene (11.5%) [Kovacevic et al., 2001], while, the main constituents of *T. polium* L. were α-pinene (19.8%), and germacrene D (11.9%). The oil of *T. scordium* L. was characterized by α-pinene (17.7%), β-pinene (10.0%) and cadinol (6.7%) [Kovacevic et al., 2001].

In *T. kabylicum*, ten components, accounting for 90.0% of the total hydrosol extract composition were identified (Table 1). The dominant classes of this extract were characterised principally by oxygenated monoterpenes (52.7%), followed by oxygenated sesquiterpenes (19.2%) and aliphatic compounds (12.5%). Oxygenated monoterpenes were dominated by terpinene-4-ol (23.5%), limonene 1-2-epoxide (15.6%) and citronellal (13.6%). Oxygenated sesquiterpenes were characterised by caryophyllene oxide (8.6%), geraniol (5.6%) and spathulenol (3.6%).

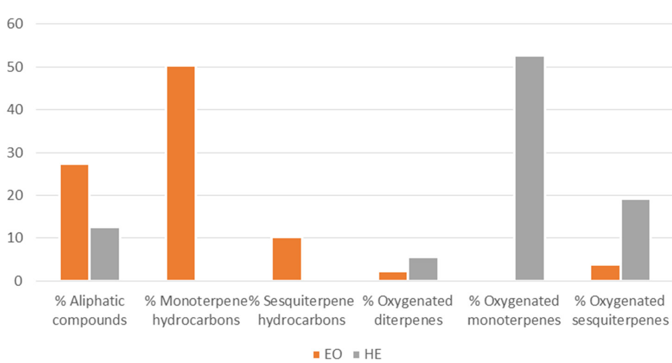

Figure 1. Percentage of different fractions of *Teucrium kabylicum* essential oil (EO) and hydrosol extract (HE) (%)

Conclusion

In the current study, the chemical composition of the essential oil and hydrosol extract of *T. kabylicum* from Algeria has been investigated for the first time. The studied chemical composition of essential oil was mainly composed of monoterpene hydrocarbons and aliphatic compounds, while hydrosol extract was consisted mainly of oxygenated components such as limonene 1-2-epoxide and citronellal terpinene-4-ol, which constitute a range of interesting bioactive compounds.

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Conflict of interest

No conflict of interest declared.

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