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## Antibacterial activity and chemical composition of the essential oil of *Satureja calamintha* ssp. *sylvatica* from Jijel, Algeria

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### ABSTRACT

The chemical composition of the hydrodistilled essential oil of *Satureja calamintha* ssp. *sylvatica*, collected from Jijel (Eastern Algerian), was analyzed by GC and GC/MS. 23 components representing 94.45% of the essential oil were detected with isopulegone (66.5%) and pulegone (11.6%) as the major components. The antibacterial activity of the essential oil was tested against 10 gram-positive and gram-negative bacteria by the use of the disc diffusion method.

**Key words:** *Satureja calamintha* ssp. *sylvatica*, Antibacterial activity

### INTRODUCTION

The genus *Satureja*, belonging to the Lamiaceae family, comprises about 30 species distributed in Tropical Africa, Europe and North America. Oils obtained from the leaves and flowers of *Satureja* spp. have found various industrial applications as flavouring materials, herbal medicine and perfumes [1]. Literature review showed variation between chemical compositions of reported *Satureja* essential oils [2-7]. Antibacterial, anticandidal, antifungal, antimicrobial, antiphytoviral, fumigant and antioxidant activities have been reported for *Satureja* essential oils [8-11]. In continuation of our works on Lamiaceae [12-31], we report here the antibacterial and chemical composition of the essential oil of *Satureja calamintha* ssp. *sylvatica*, collected from Jijel (Eastern Algerian), which is locally used to perfume tea and soups and against fever, influenza and gastric pains.

### MATERIALS AND METHODS

#### Plant material

The aerial parts of *Satureja calamintha* ssp. *sylvatica* were collected in September 2012, from Jijel (North Eastern Algeria). A voucher specimen (LOST Sc/09/12) was deposited in the herbarium of the University Constantine 1, Constantine, Algeria.

#### Extraction of the essential oil

The hydrodistillation of fresh aerial parts (100 g) of *Satureja calamintha* ssp. *sylvatica*, for 3h in a Clevenger-type apparatus, according to the British Pharmacopeia, yielded 2.1 % of a yellow good smell essential oil.

#### Gas Chromatography-Mass spectrometry

GC analysis was performed on a Shimadzu GC17A gas chromatograph equipped with a cross-linked DB5-MS column (40 m × 0.18 mm, film thickness 0.18 µm). The oven temperature was programmed as isothermal at 60°C

for 5 min, then raised to 275°C at 5°C/min and held at this temperature for 5 min. Helium was used as the carrier gas at a rate of 1 ml/min. GC/MS was performed using a Shimadzu QP5050 mass selective detector. Operating conditions were the same as for the analytical GC. The MS operating parameters were as follows: ionization potential, 70 eV; ionization current, 2 A; ion source temperature, 200°C; resolution, 1000. scan time, 5 s; scan mass range, 40–400 u; split ratio, 1:10.

### Identification of components

Essential oil components were identified based on their retention indices (determined with reference to a homologous series of normal alkanes), and by comparison of their mass spectral fragmentation patterns with those reported in the literature [32,33] and with authentic compounds.

### Antibacterial activity

The antibacterial activity of the essential oil was tested against a range of microorganisms, namely *Escherichia coli* ATCC 25922, *Escherichia coli*, *Staphylococcus aureus* ATCC 43300, *Staphylococcus aureus*, *Pseudomonas aeruginosa* ATCC 27853, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae*, *Enterobacter aerogenes*, *Proteus mirabilis*, *Streptococcus and*. The reference strains were obtained from the Pasteur Institute (Algiers). The other strains were obtained from the laboratory of bacteriology, Benbadis Hospital, Constantine, using conventional methods (clinical isolation) [34].

## RESULTS AND DISCUSSION

### Chemical composition of the essential oil

The hydrodistillation of the aerial parts of *Satureja calamintha* ssp. *sylvatica*, collected from Jijel (Eastern Algerian), yielded 2.1% (w/w) of a yellowish good smell oil. 23 compounds were identified by GC and GC/MS, representing 94.45% of the essential oil mainly characterized by isopulegone (66.5%), pulegone (11.6%) and limonene (3.4%). Isopulegone (2.40%, 5.45%) was mainly detected in the essential oils of *S. brownei* [35] and *S. boliviana* [36], respectively while pulegone (12.6–72.42%, ) was found to be a main component of the essential oil of *S. alpina*, *S. glabella*, *S. viminea*, *S. grandiflora*, *S. odora* [37–41], respectively. It's important to mention that pulegone is a chemotype of *Mentha* [43]. Limonene (3.14–16.3%) was reported as a major component of the essential oils of *S. fukarekii*, *S. montana* ssp. *kitabellii*, *S. cuneifolia*, *S. macrautha*, *S. kitabailii* and *S. wiedemanniana* [44–48], respectively. From the literature, it appears that there is no *Satureja* essential containing, simultaneously, the major components isopulegone and pulegone, found in the present essential oil.

Table 1: Chemical composition, Retention indices and percentage composition of the essential oil of *Satureja calamintha* ssp. *sylvatica*

Pic	Compound <sup>a</sup>	RI <sup>b</sup>	(%)
1	α-Pinene	937	0.59
2	β-Pinene	978	1.50
3	tert-Butylbenzene	990	0.37
4	Limonene	1028	3.41
5	1,8-Cineole	1032	0.21
6	cis-Isopulegone	1148	66.50
7	Camphor	1146	0.10
8	Menthone	1153	1.86
9	Terpinen-4-ol	1177	0.72
10	Nerol	1228	0.19
11	Pulegone	1240	11.60
12	Carvone	1242	0.10
13	cis-Piperitone oxide	1254	2.70
14	Piperitone	1282	1.41
15	E-Caryophyllene	1419	0.48
16	Germacone-D	1485	0.10
17	γ-Cadinene	1514	0.13
18	Spathulenol	1578	0.46
19	Caryophyllene oxide	1583	0.70
20	Cubanol	1647	0.11
22	α-Cadinol	1654	1.15
23	Ascabin	1762	1.06
	<b>Identified compounds</b>	<b>Total</b>	<b>94.45</b>

<sup>a</sup>Compounds listed in order of their RI

<sup>b</sup>RI (retention index) measured relative to n-alkanes (C<sub>6</sub>-C<sub>24</sub>) using DB-5MS column

### Antibacterial activity

The essential oil exhibited the best antibacterial activity against *Escherichia coli* ATCC, *Enterobacter* sp. (HS) and *Proteus* sp. (HS) with 25 mm, 22 mm, 20.5 mm inhibition zone diameters, respectively (Table 2).

Table 2: Antibacterial activity (inhibition zones and MIC) of the essential oil of *Satureja calamintha* ssp. *Sylvatica*

Microrganism	Inhibition zone <sup>a</sup> (mm)	MIC (µg/ml)
<i>Escherichia coli</i> ATCC 25922	25	20
<i>Escherichia coli</i> (HS) <sup>b</sup>	18	40
<i>Pseudomonas aeruginosa</i> ATCC 278	14	40
<i>Pseudomonas aeruginosa</i> (HS)	12.5	40
<i>Staphylococcus aureus</i> ATCC 43300	18	80
<i>Staphylococcus aureus</i> (HS)	14	80
<i>Klebsiella pneumoniae</i> (HS)	15	80
<i>Enterobacter aerogenes</i> (HS)	20.5	40
<i>Proteus mirabilis</i> (HS)	22	20
<i>Streptococcus enterococcus</i> (HS)	16	40

<sup>a</sup>: (128 µg/ml)<sup>b</sup>: (HS: Hospital Strain)

### CONCLUSION

The essential oil of *Satureja calamintha* ssp. *sylvatica*, collected from Jijel (Eastern Algerian), is characterized by the main presence of isopulegone (66.5%) and pulegone (11.6%). It's the first time that a *Satureja* oil contains isopulegone and pulegone together, as major components. The oil exhibited a good antibacterial activity against *Escherichia coli* ATCC, *Enterobacter sp.* (HS) and *Proteus sp.* (HS).

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