

## Essential oil composition of *Baccharis linearis* (Ruiz & Pav.) Pers. and *Baccharis paniculata* DC. leaves from Chile

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### Abstract

We report the chemical composition of the essential oils from fresh leaves of *Baccharis linearis* and *Baccharis paniculata* collected in San Carlos de Apoquindo, Chile. The essential oils were isolated by hydrodistillation and analyzed with gas chromatography-mass spectrometry. The major constituents in both species were monoterpenes and sesquiterpenes, representing the 84.47% and 90.36% of the total essential oil of *B. linearis* and *B. paniculata* respectively. In both species,  $\beta$ -pinene and limonene were the main compounds.

**Keywords:**  $\beta$ -pinene, limonene,  $\beta$ -himachalene,  $\gamma$ -cadinene.

### 1. Introduction

The genus *Baccharis*, one of the largest in the tribe Asteraceae (Compositae), includes c. 400 American species of shrubs, occasionally small trees and herbs<sup>[1]</sup>. *Baccharis* is an important source of natural medicinal products in different cultures<sup>[2]</sup>. Given the pharmacological properties of the genus, the chemical composition of essential oils from several species was investigated<sup>[3, 4, 5]</sup>. Essential oils are used by human been in traditional medicine and as additives in cosmeceuticals and food industry among others<sup>[6, 7]</sup>. In addition, essential oils studies from different taxa revealed their multifunctional properties, like antibacterial, antiviral, antifungal, insecticides, allelopathy, etc.<sup>[8, 9]</sup>.

For Chile, there are mentioned 39 native species of *Baccharis*<sup>[10]</sup>. Regarding the leaf essential oil, there are only reports of *B. magellanica* (Lam.) Pers. and *B. elaeoides* Remy<sup>[11]</sup>. *B. linearis* (Ruiz & Pav.) Pers. is distributed in Argentina and Chile and their leaf oils compositions from Argentinean Patagonia was reported<sup>[4]</sup>. In Chile, *B. linearis* is distributed from the third to the tenth region<sup>[10]</sup>. The leaves are used for the treatment of hypertension and mountain sickness<sup>[12, 13]</sup>. There are no reports of their essential oils composition from Chilean plants. Between the fourth and the eighth region is also present *B. paniculata* DC, that presents an aromatic resin in leaves and no study has been reported.

The aim of this study is to contribute to the chemical knowledge of these two Chilean *Baccharis* species, which could be useful for future studies. We analyzed the leaves essential oils of *B. linearis* and *B. paniculata* by gas chromatography-mass spectrometry (GC-MS).

### 2. Material and methods

#### 2.1 Plants Sample

Green leaves of *B. linearis* and *B. paniculata* were collected on the Andean foothills in central Chile (San Carlos de Apoquindo, Metropolitan Region; 33°27'S, 70°42'W, 900 m a.s.l.) in March of 2013. The climate is of a Mediterranean type with rainfall concentrated in the winter season<sup>[14]</sup>. The vegetation is sclerophyllous shrubland or woodland. Typical species are *Acacia caven* Molina, *Colliguaya odorifera* Molina, *Lithraea caustica* (Molina) Hook. & Arn. and *Quillaja saponaria* Molina. Voucher specimens of *B. linearis* (CONC 164382) and *B. paniculata* (CONC 163078) are kept at the Concepcion University Herbarium (CONC).

#### 2.2 Essential oils extraction and GC-MS conditions:

The essential oil was extracted from 250 g of fresh leaves of each species for 4 h by hydrodistillation in a Clevenger-type apparatus. The essential oil component analysis was performed by a Hewlett Packard 5890 gas chromatograph linked to a Hewlett Packard 5972 mass spectrometric detector. The compounds separation was performed by a SPB-5 column

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(0.25  $\mu\text{m}$  film thickness, 30 m x 0.25 mm, Supelco Inc., Deerfield IL, USA). The initial temperature was 35  $^{\circ}\text{C}$  (5 min) and the column was then programmed at 5  $^{\circ}\text{C}/\text{min}$  to 260  $^{\circ}\text{C}$  (5 min). The carrier gas was helium at a flow rate of 1 ml/min. The temperature of the injector was 250  $^{\circ}\text{C}$ . The identification of the compounds was achieved by comparison of their mass spectra with a library database (NIST 2011). Also, mass spectra of the peaks were compared with published spectrometric data. Spectra were considered coincident if the similarity index was higher than 95%. Retention indexes (RI) were calculated to confirm identifications. The percentage of compounds was calculated from the peak areas of the chromatograms.

### 3. Results and discussion

The essential oil yield was 1.5% for *B. linearis* and 1.3% for *B. paniculata*. The Table 1 summarizes the qualitative and quantitative GC-MS analysis of the essential oil obtained in San Carlos de Apoquindo, Metropolitan Region. A total of 16 compounds were identified for *B. linearis*, constituting 84.47% of total essential oil. This is characterized by monoterpenes (35.91%) and sesquiterpenes (48.56%). The main compounds were:  $\beta$ -pinene, limonene,  $\beta$ -himachalene and  $\gamma$ -cadinene. In the other hand, 22 compounds were identified for

*B. paniculata*, constituting 90.36% of total essential oil. The essential oil is composed by monoterpenes (48.84%) and sesquiterpenes (41.52%). The main compounds were:  $\beta$ -pinene, limonene,  $\alpha$ -phellandrene and germacrene D.

The predominance of monoterpenes and sesquiterpenes coincide with others essential oils of *Baccharis* species [13, 15]. From the essential oils of Argentinean *Baccharis* species more than 100 constituents have been identified and sesquiterpenes were majority [15].

*B. linearis* from Chile and Argentina share similar monoterpenes and sesquiterpenes. For example, limonene,  $\beta$ -pinene,  $\alpha$ -terpinene,  $\beta$ -elemene, camphene and  $\alpha$ -phellandrene. In both species, limonene and  $\beta$ -pinene are principal constituents [4].

*B. paniculata* share similar constituents with other *Baccharis* species. For example, with *B. racemosa*, *B. latifolia* and *B. linearis* share  $\alpha$ -pinene,  $\beta$ -pinene, limonene and  $\alpha$ -cadinol [4, 5, 16], with *B. salicifolia* share  $\alpha$ -phellandrene, camphene and caryophyllene oxide [15, 16] and with *B. dranunculifolia* share  $\gamma$ -terpinene, terpinen-4-ol and  $\gamma$ -gurjunene [16].

Several of the identified compounds have antimicrobial activity. Studies reveal that  $\gamma$ -terpinene, limonene, terpinen-4-ol and  $\alpha$ -cadinol have activity against *Staphylococcus aureus* [17, 18].

**Table 1:** Qualitative and quantitative composition of the essential oils of *B. linearis* and *B. paniculata* leaves from Chile

Compound	<i>B. linearis</i> a	<i>B. paniculata</i> a	RI
Monoterpenes			
$\alpha$ -pinene	2.47	4.02	938
camphene	-	1.47	940
$\beta$ -pinene	12.83	16.58	993
$\alpha$ -phellandrene	-	7.71	1010
limonene	16.86	9.58	1031
Z- $\beta$ -ocimene	-	5.29	1035
$\alpha$ -terpinene	1.7	1.75	1062
terpinen-4-ol	2.05	2.44	1185
Sesquiterpenes			
$\beta$ -elemene	1.87	2.83	1371
$\beta$ -cubebene	2.83	2.55	1390
$\alpha$ -gurjunene	-	3.27	1412
$\beta$ -caryophyllene	1.19	5.42	1438
$\beta$ -himachalene	11.78	1.36	1449
$\alpha$ -humulene	1.08	1.79	1457
$\gamma$ -gurjunene	-	2.99	1469
$\gamma$ -muurolene	1.29	0.79	1480
germacrene D	6.12	6.27	1496
$\gamma$ -cadinene	9.36	4.66	1515
$\alpha$ -elemol	-	1.15	1550
caryophyllene oxide	5.34	2.02	1594
$\tau$ -muurolol	3.43	1.72	1615
$\alpha$ -cadinol	4.27	3.98	1653
Not identified	15.53	9.64	

The genus *Baccharis* is widely distributed in arid and semiarid regions and has been proposed as nurse plants<sup>[19,20]</sup>. The nurse species can benefit the germination, establishment and the performance of beneficiary plants found beneath its canopy<sup>[21]</sup>. In this context, *Baccharis* species would exert an important role in the Chilean matorral succession<sup>[20]</sup>. However, extracts and compounds from some *Baccharis* species have shown allelopathic activity<sup>[22]</sup>. For example, *Trichocereus pasacana* (Cactaceae) seeds have been found under the canopy of *B. boliviensis*, but aqueous extracts from *B. boliviensis* leaves reduce *T. pasacana* germination<sup>[19]</sup>. In line with this, the chemistry information of *B. linearis* and *B. paniculata* reports in this work could be considered in further ecological studies.

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