

Chemical composition of the essential oil from the leaves of *Adesmia bijuga* Phil., Fabaceae, one critically endangered species in Central Chile

[Composición química del aceite esencial de las hojas de *Adesmia bijuga* Phil., Fabaceae, una especie en peligro crítico en Chile central]

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Abstract

The essential oil chemical profile of *Adesmia bijuga* Phil. leaves, an endemic Chilean species from Maule Region central Chile with a critically endangered situation, was investigated for first time. This essential oil was isolated by hydrodistillation and analyzed by gas chromatography-mass spectrometry (GC-MS). As a result, 29 components were identified; representing 94.8% of the oil composition. The major constituents were spathulenol (24.3%), cadalene (9.6%), α -copaene (8.5%) and ledol (8%).

Keywords: *Adesmia bijuga*; Fabaceae; essential oil; endemic plant

Resumen

La composición química del aceite esencial de las hojas frescas de *Adesmia bijuga* Phil., una especie chilena endémica de la Región del Maule, Chile central, en peligro crítico, fue investigada por primera vez. El aceite esencial fue aislado por hidrodestilación y analizado por cromatografía de gases acoplada a espectrometría de masas (CG-EM). Como resultado, se identificaron 29 compuestos, representando 94,8% de la composición del aceite. Los constituyentes mayoritarios fueron espatulenol (24,3%), cadaleno (9,6%), α -copaeno (8,5%) y ledol (8%).

Palabras Clave: *Adesmia bijuga*; Fabaceae; Aceite esencial; planta endémica

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INTRODUCTION

The genus *Adesmia*, endemic to South America, includes more than 230 species (Burkart, 1967; González, 2004). This genus consists of two subgenera: *Adesmia* Burkart distributed in the Andes Mountain and in the semiarid zones of Argentina and Brazil; and *Acanthadesmia* Burkart, distributed principally along of the Andes Mountain (Burkart, 1967; Miotto, 1993; Davyt and Izaguirre, 1996; Ulibarri and Burkart, 2000; Mihoc *et al.*, 2006). For Chile there are mentioned approximately 140 native species (Marticorena and Quezada, 1985).

Adesmia belongs to the Fabaceae, a great family of plants with a large number of species in the world (over 18.000) and studied extensively because of their economical, pharmacological and nutritional importance (Allen and Allen, 1981; Hegnauer and Hegnauer, 1994; Barbosa *et al.*, 2009). However, little is known about the chemistry and pharmacology of species of the genus *Adesmia* (Muñoz *et al.*, 1981; Agnese *et al.*, 1989; Agnese *et al.*, 2001; Faini *et al.*, 1995; González *et al.*, 2003; González *et al.*, 2004; Simirgiotis *et al.*, 2012).

The interest in the study of essential oils, from new natural sources, had increased during the last years. In addition to their classical roles as food additives and/or fragrances, they may also act as antibacterial, antiviral, antifungal, insecticides, herbicides, therapeutic agents, etc. (Ibrahim *et al.*, 2001; Bakkali *et al.*, 2008; Miguel, 2010; Rubiolo *et al.*, 2010).

Adesmia bijuga Phil. (Fabaceae) is an aromatic endemic shrub of Central Chile, classified as a critically endangered species (Gómez *et al.*, 2009; Gómez *et al.*, 2012). The characteristic presence of large amounts of resin in the aerial part of this species and because no phytochemical studies had been reported, led us to analyze the essential oil composition of *A. bijuga* Phil. leaves using gas chromatography/mass spectrometry (GC-MS).

MATERIALS AND METHODS

Plants Sample

Green dark brilliant *A. bijuga* Phil. leaves were collected in spring from San Pedro farm (Mediterranean of Maule Region; 35°29'31" S, 72°22'47" W). Voucher specimens are kept at the Talca University Herbarium (N° 3141). In this area, the topography is the mountain with soft waviness and elevations of up to 400 m of altitude. The geological substratum is a crystalline basement of

metamorphic rocks and granitic material on which there has developed a red Mediterranean soil of the series Constitución (Pinochet, 1991; Gómez *et al.*, 2009). The climate is of a Mediterranean type with rainfall concentrated in the winter season (Di Castri and Hajek, 1976).

Essential oil extraction and analysis

The essential oil was extracted from 500 g of fresh leaves for 4 h by hydrodistillation in a Clevenger-type apparatus. The essential oil composition was performed on 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 (0.25 µm film thickness, 30 m x 0.25 mm, Supelco Inc., Deerfield IL, USA). The initial temperature was 35°C (5 min) and the column was then programmed at 5°C/min to 260 °C (5 min). The carrier gas was helium at a flow rate of 1 ml/min. The temperature of the injector was 250°C. The identification of the compounds was achieved by comparison of their mass spectra with a library database (NIST 1998) and co-injection of standards (α -pinene, β -pinene, aromadendrene, ledol and cubenol) purchased from Sigma-Aldrich (St. Louis, MO, USA). 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.

RESULTS AND DISCUSSION

In this study, the essential oils yield was 1.5% according to the season. A total of 29 compounds were identified (Table 1), constituting 94.8% of total essential oil of *A. bijuga*. Sesquiterpenes (87%) was the main group of constituents where the principal compounds were spathulenol, cadalene and α -copaene. Some sesquiterpenes of the essential oils of *A. bijuga* were similar to those reported for *Adesmia boronioides* (Fabaceae) (González *et al.*, 2004). The remaining of the essential oil is composed by numerous lipophilic components, reaching a 22.45% of high molecular weight alcohols in *Adesmia trijuga* (Fabaceae) (Agnese *et al.*, 1998).

In general, the presence of resin in the aerial parts suggests its potential utility in fragrance and food industry.

On the other hand to emphasize that as in *A. bijuga* the sesquiterpenes they are important and are presents in the essential oils of other plants i.e. *Aristolochia chilensis* Miers Bridges ex Lindl., *Baccharis salicifolia* Nutt., *Cyperus rotundus* L., *Eugenia uniflora* L., *Hymenocrater longiflorus* Benth, *Laurelia philippiana* Looser, *Pistacia atlántica* Desf., *Pouteria splendens* Kuntze, *Solidago chilensis* Meyen, between others (Malizia et al., 2005b; Sotes et al., 2006; Urzúa and Sotes, 2008; Barboza et al., 2009; Bittner et al., 2009; Miguel, 2010) and with diverse functions like vegetable hormones, antibiotics and allelopathic properties (Kobaisy et al., 2001)

A. bijuga Phil. is a critically endangered species, immerse in vulnerable habitat with restricted spatial distribution. Since the species was described by R.A. Philippi (1884), it has not been collected again until 2003 (Hahn and Gómez, 2008). Approximately 400 individuals between adults and juvenile are immersed in *Pinus radiata* D. Don. plantations with low probability of survival. Therefore, it is imperative to conduct new research to learn more about the species and which allow developing future conservation plans. The loss of the species leads to a detriment in the knowledge of the biodiversity of the country.

Table 1
Percentage composition of the essentials oils of *Adesmia bijuga* leaves during spring growth

Compounds	RI	%	Identification
2-Hexenal	840	tr	RI, MS
α -Pinene	938	0.5	RI, MS, Co-I
Camphene	940	tr	RI, MS
β -Pinene	993	0.3	RI, MS, Co-I
1-octanol	1070	0.2	RI, MS
Decanal	1215	0.1	RI, MS
β -Elemene	1370	0.6	RI, MS
α -Copaene	1380	8.5	RI, MS
1-Tetradecene	1395	tr	RI, MS
Tetradecane	1400	tr	RI, MS
Dodecanal	1410	1.1	RI, MS
Aromadendrene	1441	2.9	RI, MS, Co-I
γ -Muurolene	1485	5.1	RI, MS
β -Dihydroagarofuran	1490	3.5	RI, MS
1-Pentadecene	1495	0.2	RI, MS
Eremophilene	1503	2.8	RI, MS
Calamenene	1511	4.3	RI, MS
Tridecanal	1515	2.1	RI, MS
γ -Cadinene	1520	2.7	RI, MS
δ -Cadinene	1525	5.1	RI, MS
Ledol	1560	8	RI, MS, Co-I
Spathulenol	1576	24.3	RI, MS
Hexadecane	1600	tr	RI, MS
Tetradecanal	1615	1.6	RI, MS
Cubenol	1620	3.5	RI, MS, Co-I
Eudesmol	1630	4.6	RI, MS
α -Bisabolol	1650	1.5	RI, MS
Cadalene	1671	9.6	RI, MS
Hexadecanal	1810	1.7	RI, MS
Not identified		5.2	

RI: Retention index; MS: Mass spectrum; Co-I: standard; tr: trace amounts (< 0.03%)

CONCLUSION

The essential oil chemical profile of *Adesmia bijuga* Phil. leaves was determined for the first time, resulting identified 29 compounds. The sesquiterpenes are the main group of constituents.

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