

# Volatile Components from the Leaves of *Solanum hypomalacophyllum* Bitter.

[Componentes volátiles de las hojas de *Solanum hypomalacophyllum* Bitter.]

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## Abstract

The essential oil from the leaves of *Solanum hypomalacophyllum* (Solanaceae) collected in May 2007 at Páramo La Culata (Mérida State, Venezuela) was obtained by hydrodistillation and its composition was determined by GC and GC/MS. Eleven compounds, representing 92.4 % of the oil, were identified 5-octen-1-ol (39.7 %), *cis*-3-hexenol (20.2 %), 1-hexanol (12.0%) and hexadecanoic acid (5.2 %) were the most abundant components.

**Keywords:** *Solanum hypomalacophyllum*; Solanaceae; essential oil; 5-octen-1-ol; GC-MS analysis.

## Resumen

El aceite esencial de las hojas de *Solanum hypomalacophyllum* (Solanaceae) recogidas en mayo 2007 en el Páramo La Culata (Estado de Mérida, Venezuela) fue obtenido por hidrodestilación y fue analizado por GC y GC/MS. Se identificaron 11 componentes que representan el 92.4% del total del aceite. Los componentes mayoritarios fueron identificados como 5-octen-1-ol (39.7 %), *cis*-3-hexenol (20.2 %), 1-hexanol (12.0 %) y ácido hexadecanoico (5.2 %).

**Palabras Clave:** *Solanum hypomalacophyllum*; Solanaceae; aceite esencial; 5-octen-1-ol; GC-MS análisis.

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## INTRODUCTION

The Solanaceae family comprises about 90 genera and 3.000 species which are widely distributed in the world. They are a rich source of active secondary metabolites (Coletto da Silva et al., 2004). Within this family, the genus *Solanum* is the largest and most complex with more than 1500 species (Chowdhury et al., 2007) which yield a great variety of steroidal saponins and glycoalkaloids of interest from ecological and human health viewpoints (Roddick et al., 2001). Numerous species of *Solanum* are known to possess a variety of biological activities including antimycotic (Gonzales et al., 2004; Singh et al., 2007), antiviral (Arthan et al., 2002), molluscicidal (Silva et al., 2006), teratogenic (Keeler et al., 1990), and cytotoxic properties (Nakamura et al., 1996; Lu et al., 2009). Previous studies reported the chemical composition of the essential oil of several species of *Solanum*, like *S. verbascifolium* (Ma et al., 2006), *S. lyratum* (Xu et al., 2006), *S. aculeastrum* (Koduru et al., 2006) and of *S. pseudocapsicum* (Aliero et al., 2006, 2007), but no reports have been published on the composition of the volatile constituents of *S. hypomalacophyllum* Bitter. This species is a small tree native to the Venezuelan Andes where it grows wild in humid places at altitudes between 2150 and 3200 meters. Previous studies reported the isolation of 4-keto steroidal alkaloids solaphyllidine, deacetyxosolaphyllidine, desacetylsolaphyllidine, spiroxosolaphyllidine and solamaladine from green berries and leaves (Usubillaga, 1970, 1984; Usubillaga et al., 1982; Alarcon et al., 2006). Therefore, in continuation of our study of the Venezuelan Solanaceae, we report here the first study on the essential oil of *S. hypomalacophyllum* in order to obtain knowledge on its chemical composition.

## MATERIALS AND METHODS

### Plant Material

Leaves of *Solanum hypomalacophyllum* were collected in May 2007, in the area of El Páramo de la Culata, Mérida State, Venezuela at 2800 m above sea level. A voucher specimen has been deposited at the MERF Herbarium (Herbarium of the Faculty of Pharmacy and Bioanalysis in Mérida, Venezuela). The botanical identification was made by Forest Engineer Juan Carmona, MERF Herbarium.

### Extraction and analysis of the essential oil

Fresh leaves (2000 g) were cut into small pieces and submitted to hydrodistillation for 3 h using a Clevenger-type apparatus. 0.1 mL of essential oil was obtained that corresponds to a yield of 0.005%  $v/w$ .

The composition of the essential oil was determined by comparison of the mass spectrum of each component with Wiley GC/MS library data and also from retention index (RI) data (Morteza et al., 2004).

### Gas chromatography

GC analyses were performed using a Perkin-Elmer Autosystem gas chromatograph equipped with a FID detector and data-handling system. A 5% phenylmethylpolysiloxane fused-silica capillary column was used (30 m x 0.25 mm i.d., film thickness 0.25  $\mu$ m; HP-5, Hewlett-Packard, CA, USA). The oven temperature was programmed from 60 °C to 260 °C at 4 °C/min. The injector and detector (Flame ionization detector, FID) temperatures were 200°C and 280 °C, respectively. The carrier gas was helium at 0.8 mL/min. The sample (1.0  $\mu$ L) was injected using a split ratio of 10:1. Retention indices were calculated by comparing the retention times of the eluting peaks with those of standard  $C_8$ - $C_{24}$  *n*-alkanes. The percentage composition of the oil was calculated by the normalization method from the GC peak areas.

### Gas chromatography – mass spectrometry

GC-MS analyses were carried out on a Model 5973 Hewlett-Packard GC-MS system fitted with a HP-5MS fused silica column (30 m x 0.25 mm i.d., film thickness 0.25  $\mu$ m, Hewlett-Packard). The oven temperature program was the same as that used for the HP-5 column for GC analysis; the transfer line temperature was programmed from 150°C to 280°C; source temperature, 230°C; quadrupole temperature, 150°C; carrier gas, helium, adjusted to a linear velocity of 34 cm/s; ionization energy, 70 eV; scan range, 40:500 amu; 3.9 scans/s. Sample (1.0  $\mu$ L) was injected using a Hewlett-Packard ALS injector with a split ratio of 50:1. The identity of the oil components was established from their GC retention indices, by comparison of their MS spectra with those of standard compounds available in the laboratory, and by a library search (NIST 05 and Wiley)(Adams, 1995).

## RESULTS AND DISCUSSION

Hydrodistillation of the leaves yielded a yellowish liquid oil in 0.005 %  $v/w$  yield. The chemical composition of the oil was investigated using both GC and GC-MS techniques. It was possible to identify 11 components, which represent 92.4% of the total oil. These compounds with their retention indices (RI) and relative percentage concentrations are listed in Table 1 according to the elution order on the HP-5 column by GC and by comparison of the fragmentation pattern. The oil was found to contain alcohols (78.2%), fatty acid (5.2%) and aldehydes (4.8%) as major components. The dominant compounds were 5-octen-1-ol (39.7 %), *cis*-3-hexenol (20.2 %), 1-hexanol (12.0 %) and hexadecanoic acid (5.2 %).

**Table 1.** Percentage composition of the essential oil of the leaves of *Solanum hypomalacophyllum*.

Peak N°	Compounds	Area (%)	RI
1	<i>Trans</i> -3-hexenol	1.4	844
2	<b><i>Cis</i>-3-hexenol</b>	<b>20.2</b>	<b>850</b>
3	<b>1-Hexanol</b>	<b>12.0</b>	<b>862</b>
4	<i>Cis</i> -4-heptenal	4.8	898
5	1-heptanol	1.6	967
6	<b>5-octen-1-ol</b>	<b>39.7</b>	<b>1071</b>
7	1-nonanol	1.4	1174
8	1-decanol	1.9	1276
9	$\beta$ -ionone	1.8	1497
10	Butylated-hydroxytoluene	2.4	1523
11	<b>Hexadecanoic acid</b>	<b>5.2</b>	<b>1961</b>
Total		92.4	

RI: retention index

## CONCLUSION

The chemical composition of the essential oil from leaves the *Solanum hypomalacophyllum* contain 5-octen-1-ol (39.7 %), *cis*-3-hexenol (20.2 %), 1-hexanol (12.0 %) and hexadecanoic acid (5.2 %). as major components. These compounds are reported for the first time in this species.

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