



# Sesquiterpene lactones from *Chrysolaena platensis*

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## 1. Subject and source

Aerial parts of *Chrysolaena platensis* (Spreng.) Robinson were collected at the flowering stage on December 28, 1997 in Misiones Province, Argentina. A voucher specimen (LIL 603539) is on deposit in the herbarium of the Fundación Miguel Lillo, Tucumán.

## 2. Previous work

A.L. Cabrera's treatment of Argentine Vernonias (Cabrera, 1944) included four members of his Section Lepidaploa, subsection Flexuosae, three of which were listed as occurring in Entre Rios Province (Cabrera, 1974). Two of these, *V. cognata* Less. and *V. platensis* (Spreng.) Less., were said to be closely related, differing from each other only in the number of flowers in the capitulum, diameter of the campanulate involucre and the thickness of the xylopodium. The two species were originally recognized by Jones (1979) as distinct members of his series Flexuosae (Cabr.) S.B. Jones but were later (Jones, 1980) without further discussion declared to be synonyms with the binomial *V. platensis* taking precedence over *V. cognata*. His description did not

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acknowledge the distinctions posited by Cabrera and in fact the synonymy is not accepted by Argentine taxonomists who consider the Cabrera characters as distinctive (private communication, also Dematteis, 1997). Subsequently, H. Robinson (1988) transferred six members of Jones' ser. *Flexuosae*, including his *V. platensis*, to a new genus *Chrysolaena*.

Before becoming aware of Jones' change of view regarding *V. cognata* and prior to Robinson's erection of the new genus *Chrysolaena* we had studied a collection of *V. cognata*, based on the Cabrera characters, from Entre Rios Province (Bardón et al., 1988). Isolated were glaucolide B (**1**), the main sesquiterpene lactone constituent, and small amounts of two C-1 isomeric piptocarphol derivatives **2a** and **3a** as well as several common triterpenes and plant sterols. Two other collections of *V. cognata* from unspecified locations in Brazil reportedly only furnished **2a** (Rustaiyan and Nazarans, 1979; Bohlmann and Zdero, 1988). Our more recent study of another *Chrysolaena* species, *C. propinqua* (Hieron.) H. Robinson (Bardón et al., 1992), the former *V. propinqua* Hieron., essentially duplicated our results on *V. cognata* while *C. verbascifolia* (Less.) H. Robinson, the former *V. verbascifolia* Less., furnished a much larger variety of piptocarphols and related sesquiterpene lactones as well as a cadinanolide (Bardón et al., 1993).

### 3. Present study

In view of the difference between the views of our Argentine botanical colleagues and those of Jones we decided to study the chemistry of a collection, based on the Cabrera characters, of *C. platensis* (Spreng.) H. Robinson. Air-dried flowers and leaves (305 g) were extracted with hexane-Et<sub>2</sub>O-CH<sub>3</sub>OH (1 : 1 : 1, 3 × 1.5 l) at room temperature to give 15 g (4.9%) of crude extract which was suspended in EtOH (128 ml) at 60°C, diluted with H<sub>2</sub>O (95 ml) and extracted successively with hexane (3 × 70 ml) and CHCl<sub>3</sub> (3 × 70 ml). Evaporation of the hexane extract at reduced pressure gave 12.3 g (4%) of residue which was subjected to CC using hexane with increasing amounts of EtOAc (5–10%) to give 160 fractions. HPLC coupled with CC-MS analysis of the various fractions results in identification of lupeol, germanicol, β- and α-amyrin, sitosterol, stigmasterol, stigmastan 3β-ol, stigmasta-7, 25-dien-3β-ol, stigmast-7-en-β-ol, caryophyllene, vitamin E, octadecane and trimethylpentadecan-2-one.

The CHCl<sub>3</sub> extract on evaporation at reduced pressure furnished 1.2 g of residue which was subjected to CC over Si gel using CHCl<sub>3</sub> with increasing amounts of EtOAc (0–100%) and finally with EtOAc containing 5% MeOH to give seven fractions (I–VII). These fractions were subjected to HPLC; the eluates were examined by <sup>1</sup>H NMR spectrometry at 500 MHz (CDCl<sub>3</sub>) and their spectra decoupled and compared with spectra of known samples. Fr I (20 mg) on HPLC (MeOH-H<sub>2</sub>O 4 : 3, 2 ml min<sup>-1</sup>) contained only unidentified mixtures. HPLC of fr II (112 mg) in the same manner furnished 6.7 mg, Rt 8 min, of **2a** (Bohlmann et al., 1979 as revised by Jakupovic et al., 1986) containing a trace of **2b** (Bardón et al., 1993) and 4.9 mg, Rt 14 min, of **2b** containing a little **2a**. HPLC of fr III (108 mg) afforded 5.2 mg of **2c**, Rt 7.5 min) (Jakupovic et al., 1986; Bardón et al., 1993), 75 mg of pure **2a**, Rt 8.5 min, and

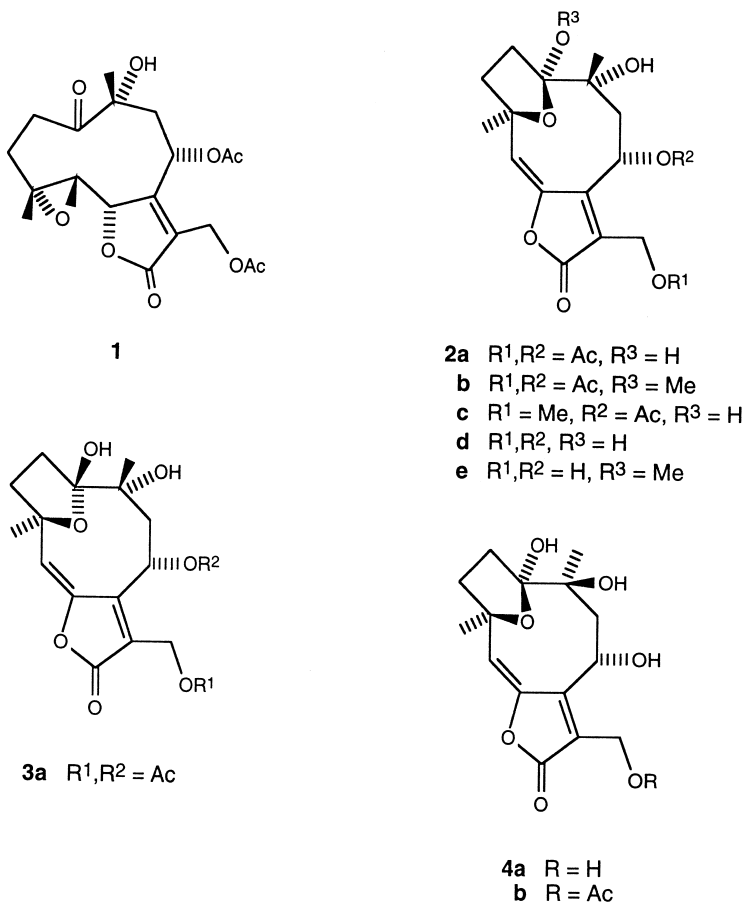


Fig. 1.

5.4 mg of pure **2b**, Rt 14 min. HPLC of fr IV (70 mg) gave 14.1 mg of **4a**, Rt 2 min (for discussion see below), 14.2 mg, Rt 3 min, and 14.5 mg, Rt 4.5 min, of mixtures containing **4a**, 15 mg, Rt 6 min, of a mixture containing **4b** and 15.2 mg, Rt 9 min, of **4b**. HPLC of fr V (217 mg) gave 21.9 mg, Rt 2 min, of **2d** (Bardón et al., 1993), 18.6 mg, Rt 3 min, of a mixture containing **2d** and some **2e** (Bardón et al., 1993) followed by mixtures with longer Rt which had a tendency to decompose. Frs VI and VII were mixtures which decomposed before being processed.

The <sup>1</sup>H NMR spectra (Table 1) of two new sesquiterpene lactone constituents from fr IV, one the 13-monoacetate of the other, differed from the spectra of piptocarphols of types **2** and **3** most obviously in the chemical shifts of the C-14 and C-15 methyl signals which appeared at  $\delta$  1.34 and 1.37 (CDCl<sub>3</sub>) vs approximately  $\delta$  1.25 and 1.6 (CDCl<sub>3</sub>) for **2a–d** and their C-1 epimers such as **3a**. The coupling constants involving H-8 and H-9a,b (12.5 and 4.5 Hz) were the same as those in piptocarphols of type

Table 1

<sup>1</sup>H NMR spectra of **4a** and **4b** (500 MHz, CDCl<sub>3</sub>)

H	<b>4a</b>	<b>4b</b>
2a	2.81 <i>ddd</i> (15, 14, 6)	2.81 <i>ddd</i> (15, 14, 5.5)
2b	2.68 <i>ddd</i> (15.5, 6, 3)	2.69 <i>ddd</i> (15.5, 5.5, 3)
3a	2.47 <i>m</i>	2.48 <i>ddd</i> (15, 14.5, 6)
3b	2.00 <i>m</i>	2.00 <i>ddd</i> (14, 5.5, 2.5)
5	5.82 <i>s</i>	5.84 <i>s</i>
8	5.40 <i>dd</i> (12.5, 4.5)	5.36 <i>dd</i> (13, 4.5)
9a	2.59 <i>dd</i> (16, 12.5)	2.54 <i>dd</i> (15, 13)
9b	2.47 (16, 4.5)	2.32 <i>dd</i> (15, 4.5)
13a	4.50 <i>s</i>	4.92 <i>d</i> (15.5)
13b	4.50 <i>s</i>	4.85 <i>d</i> (15.5)
14 <sup>a</sup>	1.34 <i>s</i>	1.33 <i>s</i>
15 <sup>a</sup>	1.37 <i>s</i>	1.37 <i>s</i>
Ac <sup>a</sup>		2.14 <i>s</i>

<sup>a</sup>Intensity 3p

**2** (group A of Bardón et al., 1988), and differed from those of type **3** (group B), while the signals of H-9b and some of the protons in the tetrahydrofuran ring were displaced toward lower field compared with both types **2** and **3** piptocarphols (Table 1). These observations could be rationalized most simply by invoking a change in stereochemistry at C-10 as depicted in formulas **4a** and **4b** since differences in chemical shifts of the various signals and  $J_{8,9}$  also ruled out structures of other possible and appropriately substituted 7,13-ene-13-hydroxygermacranolides, guaianolides and cadinanolides found previously in *Vernonia sensu lato*. Unfortunately the new substances decomposed in the NMR tubes prior to elemental analysis and further study.

#### 4. Chemotaxonomic significance

Although chemical evidence of the type presented in this article must be interpreted with caution, the absence of glaucolide A (**1**), the most abundant sesquiterpene lactone constituent of *Vernonia cognata* Less, and the variety of piptocarphol derivatives in *Chrysolaena platensis* (Spreng.) H. Robinson several of which were not previously reported from *V. cognata* appear to support the view of those taxonomists who believe the two taxa to be distinct.

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