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SESQUITERPENE LACTONES FROM *LACTUCA SATIVA*

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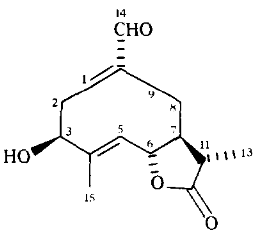
Key Word Index—*Lactuca sativa*; Compositae; sesquiterpene lactones; guaianolides; melampolide.

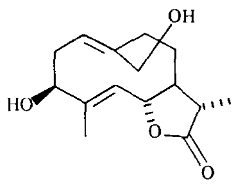
Abstract—The aerial parts of *Lactuca sativa* afforded lactucin, 11β,13-dihydrolactucin, lactupicrin, a new melampolide and 3β,14-dihydroxy-11β,13-dihydrocostunolide.

From the aerial parts of wild growing *Lactuca sativa* L., which is cultivated as a vegetable throughout Europe, so far only triterpenes have been reported [1]. We now have studied again this species. In addition to the triterpenes (see Experimental), lactucin [2, 3], lactupicrin [3, 4] and 11β,13-dihydrolactucin [5], two further sesquiterpene lactones were obtained (**1** and **2**). From the molecular ion of **1** the molecular formula $C_{15}H_{20}O_4$ was deduced. The IR spectrum exhibited bands typical for hydroxyl (3600), γ-lactone (1770) and conjugated aldehyde groups (2730, 2690, 1630 cm^{-1}). The structure was elucidated from the ^{1}H NMR spectrum (Table 1). The presence of an 11β,13-dihydro derivative of a methylene lactone followed from the methyl doublet at $\delta 1.15$ and double quartet at $\delta 2.18$. The coupling of 12 Hz indicated an 11β-proton. Spin decoupling starting with the signal at $\delta 2.18$ allowed the assignment of the whole sequence as H-1 showed an allylic coupling with H-9β. The chemical shift of H-14 required $\Delta^{1(10)}$ double bond with the *E*-configuration and the coupling of H-3 agreed with the presence of a 3β-hydroxy derivative. Thus the structure and the stereochemistry of the lactone was established as **1**, 3β-hydroxy-11β,13-dihydroacanthospermolide. It is closely related to an isomeric melampolide with an 8β-hydroxyl group instead of the 3β-hydroxyl which was isolated from *Blainvillea* species [6]. Also urospermal A [7] from *Urospermum* species which is in the same tribe as *Lactuca*, is an acanthospermolide derivative.

The structure of **2**, molecular formula $C_{15}H_{22}O_3$, also followed from the ^{1}H NMR spectrum (Table 1). All signals could be assigned by spin decoupling. As the broadened doublet at $\delta 4.76$ was coupled both with H-6 and H-15 the relative position of the secondary hydroxyl group was settled. Similarly the fact that the threefold doublet at $\delta 2.32$ was coupled with H-1 and the lowfield double doublet at $\delta 4.30$ indicated a secondary hydroxyl group at C-3. The configuration at C-3 and C-11 followed from the couplings. Compounds **1** and **2** are closely related. As in other cases the presence of a 14-carbonyl group induces an isomerization of the 1(10)-double bond. The chemistry of this species again shows that 11β,13-dihydro derivatives of sesquiterpene lactones are common in the tribe Cichorieae.



1



2

Table 1. ^{1}H NMR spectral data of **1** and **2** (400 MHz, $CDCl_3$, δ-values)

H	1	2
1	6.54 *ddd*	4.99 *br dd*
2	2.55 *ddd*	2.47 *m*
2′	2.49 *ddd*	2.32 *ddd*
3	4.24 *dd*	4.30 *dd*
5	4.99 *br d*	4.76 *br d*
6	4.67 *dd*	4.59 *dd*
7	1.27 *dddd*	1.67 *m*
8α	1.44 *dddd*	1.69 *m*
8β	2.71 *dddd*	1.89 *m*
9α	2.38 *br dd*	2.82 *m*
9β	2.04 *dddd*	
11β	2.18 *dq*	2.26 *dq*
13	1.15 *d*	1.26 *d*
14	9.43 *br s*	4.26 *d* 3.82 *d*
15	1.90 *br s*	1.63 *d*

J (Hz): compound **1**: 1,2 = 10; 1,2′ = 8; 1,9β = 1.5; $2\alpha,2\beta$ = 12; 2α,3 = 11; 2β,3 = 3; 5,6 = 6,7 = 10; 7,8β = 3; 7,8α = 12; 7,11 = 12; 8,9 = 6.5; 8,8′ = 13; $8\beta,9\beta$ = 12; $8\alpha,9\beta$ = 12; 9,9′ = 15. Compound **2**: 1,2 = 4; 1,2′ = 12; 2,2′ = 12; 2,3 = 6; 2,3 = 10; 5,6 = 10; 6,7 = 9; 7,11 = 12; 11,13 = 7.

EXPERIMENTAL

Fresh, wild growing aerial parts (3 kg) collected near Alexandria, Egypt, were extracted with Et_2O–petrol (1 : 2) and the resulting extract was first separated by CC (SiO_2) using petrol, $CHCl_3$ and $CHCl_3$–MeOH (20 : 1). The nonpolar fractions gave 400 mg lupeyl acetate, 600 mg lupeol, 50 mg sitosterol while the polar fractions ($CHCl_3$–MeOH) gave 15 mg sitosterol glucoside, 3 mg lactucin, 5 mg lactupicrin, 75 mg **1** and a mixture which by HPLC (Rp8, MeOH–H_2O, 1:1) gave 4 mg 11β,13-dihydrolactucin, R_t 2.4 min) and 16 mg **2** (R_t 3.4 min). Known compounds were identified by comparison with authentic materials (mp, mmp, co-TLC and ^1H NMR).

*3β-Hydroxy-*11β,13*-dihydroacanthospermolide* (**1**). Colourless crystals, mp 197°; UV λ_{max}^{MeOH} 230 nm; IR $\nu_{max}^{CHCl_3}$ cm^{-1}: 3600 (OH), 2730, 1690, 1630 (C=CCHO), 1770 (γ-lactone); MS *m/z* (rel. int.): 264.136 $[M]^+$ (10) $[C_{15}H_{20}O_4]^+$, 246 $[M - H_2O]^+$ (8), 235 $[M - CHO]^+$ (4.5), 218 $[246 - CO]^+$ (20), 109 (100):

$$[\alpha]^{\lambda}_{24^\circ} = \frac{589 \quad 578 \quad 546 \quad 436\,\text{nm}}{-87 \quad -93 \quad -112 \quad -207} \,(\text{CHCl}_3;\, c\ 0.6).$$

3β-14*-Dihydroxy-*11β,13*-dihydrocostunolide* (**2**). Colourless crystals, mp 110°; IR $\nu_{max}^{CHCl_3}$ cm^{-1}: 3600 (OH), 1765 (γ-lactone); MS *m/z* (rel. int.): 266.152 $[M]^+$ (14) (calc. for $C_{15}H_{22}O_4$: 266.150), 248 $[M - H_2O]^+$ (32), 207 $[M - C_7H_5O]^+$ (100), 179 $[207 - CO]^+$ (28); $[\alpha]_D^{24^\circ} = +110$ (MeOH; *c* 0.1).

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HELIANGOLIDES AND ACYCLIC DITERPENE FROM *VIGUIERA GILLIESII*

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Key Word Index—*Viguiera gilliesii*; Compositae; aerial parts; heliangolides; acyclic diterpene; structural determination.

Abstract—The aerial parts of *Viguiera gilliesii* afforded five heliangolides and one new acyclic diterpene, (*E*,*Z*,*Z*)-3,7,11-trihydroxymethyl-15-methyl-2,6,10,14-hexadecatetraen-1-ol. Structures were elucidated by spectroscopic methods and by comparison of the data with those of closely related compounds.

INTRODUCTION

As part of a general phytochemical investigation of the native vegetation of the Cuyo Region (Argentina), we have studied *Viguiera gilliesii* Hook et Arn collected in Villavicencio (Mendoza). Reports on about 25 *Viguiera* species have appeared so far. Furanoheliangolides and heliangolides as well as diterpenes are characteristic constituents but germacradienolides have also been found.

RESULTS AND DISCUSSION

The aerial parts of *V. gilliesii* afforded a complex mixture of sesquiterpene lactones (**1a**, **b**, **2a**, **b** and **3**) which could be separated only with difficulty, as well as the acyclic diterpene **4a**.

The major lactone, **2a**, colourless oil, $[\alpha]_D$ −77.9 showed a molecular ion at *m/z* 366, which agreed with formula $C_{20}H_{30}O_6$. Its IR spectrum suggested the presence of an α-methylene-γ-lactone, hydroxyl groups and