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IRIDOID GLUCOSIDES OF *LINARIA CLEMENTEI*

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Key Word Index—*Linaria clementei*; Scrophulariaceae; iridoid glucosides; antirride, antirrinoside, 6-senecioyl-antirrinoside; 6-angeloylantirrinoside.

Abstract—From an acetone extract of the whole plant of *Linaria clementei*, besides antirride and antirrinoside, the new iridoid glucosides 6-senecioyl- and 6-angeloylantirrinoside were isolated.

Linaria clementei Boiss (Scrophulariaceae) is widely distributed in Spain. Up to the present time nothing has been reported about the chemistry of this species. From an acetone extract of the whole plant we have isolated in addition to the known iridoid glucosides antirride [1] and antirrinoside (**1a**) [2], 6-senecioylantirrinoside (**2a**) and 6-angeloylantirrinoside (**3a**), which to my knowledge are new substances, and whose structures were determined as follows.

Compounds **2a** and **3a** were isolated as an inseparable mixture which showed a single spot in TLC with several eluents. The combustion analysis of the mixture gave a molecular formula $C_{20}H_{28}O_{11}$. Its UV and IR spectra showed absorptions at 225.5 nm (log ε3.77), 1710 and 1655 cm^{-1}, respectively. Acid hydrolysis of the mixture afforded glucose as the sole sugar; on the other hand, acetylation under mild conditions gave a mixture of tetra-acetates, **2b** + **3b**. Alkaline hydrolysis of **2a** + **3a** yielded a mixture of senecioic and angelic acids, besides antirrinoside (**1a**), identified by its physical and spectroscopic data and by direct comparation with an authentic sample. These facts establish that **2a** + **3a** is a mixture of the senecioate and angeloate of antirrinoside and that they occur in *ca* 1:1 ratio is indicated by integration of the olefinic protons corresponding to the ester groups in the ^1H NMR spectrum. These acids must be located at C-6 on the basis of the H-9 resonance in the ^1H NMR spectrum of **2a** + **3a**, at 2.46 ppm, which excludes position C-5. Additional evidence for this assignment was obtained from the ^1H NMR comparative data of H-6: δ5.20–4.80 in **1b** [2] and 5.05–4.96 in **2a** + **3a**, whereas in **1a** it appears at δ4.00 [2].

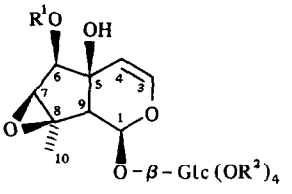
EXPERIMENTAL

The plant material used in this study was collected in July 1981 at Ojén, Málaga (Spain). Voucher specimens are deposited in the *Herbarium of the Faculty of Pharmacy (Madrid 'Complutense' University)*.

Extraction and isolation. Dried and powdered whole plant (3 kg) were extracted with acetone (10 l.) at room temp. for one week. Removal of the solvent gave 110 g of extract which was chromatographed on silica gel (Merck, no. 7734), deactivated with 10% H_2O, using gradients of *n*-hexane–EtOAc and $CHCl_3$–MeOH. The eluted products in order of increasing polarity were: **2a** + **3a** (13 g), antirride (1 g) and antirrinoside (**1a**; 6 g).

6-Senecioyl-antirrinoside (**2a**) *and 6-angeloyl-antirrinoside* (**3a**). Amorphous powder; IR ν_{max}^{KBr} cm^{-1}: 3700–3000, 2940, 1720, 1710, 1655, 1230, 1080, 1020, 968; UV λ_{max}^{MeOH} nm (log ε): 225.5 (3.77); ^1H NMR (90 MHz, CD_3OD): δ6.40 (1H, *d*, *J* = 6 Hz, H-3), 5.46 (1H, *d*, *J* = 6 Hz, H-1), 4.90 (1H, *dd*, *J* = 6, 2 Hz, H-4), 3.50 (1H, *t*, *J* = 3 Hz, H-7), 2.46 (1H, *d*, *J* = 6 Hz, H-9), H-6: 5.05, *d*, *J* = 3 Hz and 4.96, *d*, *J* = 3 Hz; Me-10: 1.50, *s* and 1.49, *s*. The signals of the senecioyl and angeloyl groups appear at δ5.83, 2.16, 1.93 and 6.16, 2.00, 1.93 respectively; ^{13}C NMR (25.2 MHz, CD_3OD): δ143.00 (*d*, C-3), 107.36 (*d*, C-4), 99.55 (*d*, C-1'), 94.87 (*d*, C-1), 78.64 and 79.35 (*d*, C-6), 78.05 (*d*, C-3'), 77.53 (*d*, C-5'), 74.50 (2C, *d*, C-5, C-2'), 71.55 (*d*, C-4'), 64.29 2C, *d*, C-7; *s*, C-8), 62.81 (*t*, C-6'), 53.30 (*d*, C-9), 17.30 (*q*, C-10). The resonances of the senecioyl and angeloyl groups appear at: δ169.26, 159.21, 116.25, 27.43, 20.57 and 167.18, 139.28, 128.71, 20.57 and 16.09, respectively. (Found: C, 53.51; H, 6.44. $C_{20}H_{28}O_{11}$ requires. C, 54.05; H, 6.35%.)

Tetraacetyl-6-senecioyl-antirrinoside (**2b**) + *tetraacetyl-6-angeloyl-antirrinoside* (**3b**). 500 mg of **2a** + **3a** treated with pyridine–Ac_2O (1:1) at room temp. for 24 hr, afforded after usual



1a $R^1 = R^2 = H$
1b $R^1 = R^2 = Ac$
2a $R^1 = COCH{=}CMe_2$, $R^2 = H$
2b $R^1 = COCH{=}CMe_2$, $R^2 = Ac$
3a $R^1 = COCMe\overset{Z}{=}CHMe$, $R^2 = H$
3b $R = COCMe\overset{Z}{=}CHMe$, $R^2 = Ac$

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work-up and column chromatography, eluting with *n*-hexane–EtOAc (2:3), 650 mg of **2b** + **3b**; mp 118–121° (EtOH); IR ν_{max}^{KBr} cm^{-1}: 3520, 2960, 1750, 1720, 1710, 1660, 1650, 1380, 1260, 1230, 1150, 1075, 1040, 1020, 960; ^{1}H NMR (90 MHz, $CDCl_3$): δ6.30 (1H, *d*, *J* = 6 Hz, H-3), 5.10 (1H, *d*, *J* = 7.8 Hz, H-1), 5.25–4.90 (6H, H-4, H-6, H-1′, H-2′, H-3′, H-4′), 4.20 (2H, *br s*, H-6′), 3.76 (1H, *m*, H-5′), 3 53 (1H, *t*, *J* = 2 Hz, H-7), 3.16 (1H, *d*, *J* = 3 Hz, OH), 2 46 (1H, *br d*, *J* = 7.8 Hz, H-9), 2.06–1.96 (12H, *s*, 4 × OAc), 1.50 (3H, *s*, Me-10); the senecioyl and angeloyl resonances appear as above; ^{13}C NMR (25.2 MHz, $CDCl_3$): δ141.22 (*d*, C-2), 107.22 (*d*, C-4), 96.37 (*d*, C-1′), 94.51 (*d*, C-1), 77 56 and 78.05 (*d*, C-6), 73.27 (*s*, C-5), 72.52 (*d*, C-3′), 72.37 (*d*, C-5′), 71.04 (*d*, C-2′), 68.59 (*d*, C-4′), 62.97 (*d*, C-7), 62.83 (*s*, C-8), 61.67 (*t*, C-6′), 52.44 (*d*, C-9), 17 03 (*q*, C-10); additional signals for acetyl, senecioyl and angeloyl groups at δ170.24–169.27, 20.46; 169 27, 158.06, 115.61, 27.35, 20.46 and 165.92, 138.95, 127.59, 20 40, 15 93, respectively. (Found: C, 54.51; H, 5.99. $C_{28}H_{36}O_{15}$ requires. C, 54.90; H, 5.88%.)

Acid hydrolysis of **2a** + **3a** in the usual manner yielded glucose, identified by conventional methods [1]. Alkaline hydrolysis according to ref. [3] afforded, in addition to senecioic and angelic acids, antirrinoside (**1a**) $[\alpha]_D^{24}$ −68.10° (dioxane; *c* 0.54), identical in all respects with an authentic sample.

Antirride [mp 152–153°; $[\alpha]_D^{24}$ −93.7° (dioxane; *c* 1 55)] and *antirrinoside* were fully characterized by analytical, physical and spectroscopic data and preparation of some derivatives. In every cases the reported values are in agreement with those obtained by us.

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REFERENCES

1. Scarpati, M. L and Guiso, M. (1969) *Gazz. Chim. Ital.* **99**, 807.
2. Scarpati, M. L., Guiso, M. and Esposito, P. (1968) *Gazz. Chim. Ital.* **98**, 177.
3. Kitagawa, I., Hino, K., Nishimura, T., Iwata, E. and Yosioka, I. (1971) *Chem. Pharm. Bull.* **19**, 2534.

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OCCURRENCE OF 24-EPIMERS OF CYCLOART-25-ENE-3β,24-DIOLS IN THE STEMS OF *EUPHORBIA TRIGONA*

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Key Word Index—*Euphorbia trigona*; Euphorbiaceae; mortenol, 24-epimeric cycloart-25-ene-3β,24-diols; betulin.

Abstract—^{13}C NMR spectroscopy has demonstrated that the cycloart-25-ene-3β,24-diol isolated from the stems of *Euphorbia trigona* is a 1:1 mixture of the 24-epimers. This seems to be the first instance of the detection of the natural occurrence of 24-epimeric cycloart-25-ene-3β,24-diols.

INTRODUCTION

In our previous communication [1] we reported the isolation of taraxeryl acetate, friedelin, friedelan-3β- and 3α-ols, taraxerol, cycloartenol, 24-methylenecycloartanol, α- and β-amyrins, lupeol, sitosterol and an unidentified triterpene alcohol from the stems of *Euphorbia trigona* Haw. We now report the characterization of the unidentified triterpenoid as mortenol together with the isolation of the 24-epimeric cycloart-25-ene-3β,24-diols and betulin.

RESULTS AND DISCUSSION

The *n*-hexane extract of *E. trigona* stems on CC gave a gummy material after separation of the monohydroxytriterpenoids [1]. This gummy material resisted crystallization and was, therefore, acetylated. Repeated CC gave compounds **1** and **2**. Compound **1** crystallized from chloroform–methanol as colourless needles, mp 122° and showed a single spot on TLC. The ^{1}H NMR spectrum of compound **1** exhibited two doublets (*J* = 4 Hz) at δ0.3 and 0.55, characteristic of cyclopropane protons in 9,19-cyclotriterpenoids, five methyls between δ0.8 and 0.95, a singlet at δ1.7 for a vinyl methyl, two acetoxyls at δ2.0, a doublet of doublets at δ4.5 assignable to an H-3α over an acetoxyl with axial–axial and axial–equitorial couplings (*J* = 10, 5 Hz), two broad singlets at δ4.9 and 4.95 due to a vinyl methylene and a triplet at δ5.1 which can be attributed to a proton α- to an acetoxyl. From the above ^{1}H NMR data it was assumed that compound A is a 9,19-cyclotriterpenoid with two acetoxyls and a side chain terminating in an isopropenyl group. The mass spectral