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CHROMENES AND BENZOFURANS FROM *AGERATINA GLECHONOPHYLLA*

ANTONIO G. GONZÁLEZ, JAIME BERMEJO BARRERA, ANGEL C. YANES, JESÚS G. DÍAZ and ELSA Mª RODRÍGUEZ PÉREZ

Centro de Productos Naturales Orgánicos Antonio González, CSIC Universidad de La Laguna, 38206 Tenerife, Canary Islands, Spain

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Key Word Index—*Ageratina glechonophylla*; Compositae; aerial parts; Eupatorieae; eudesmenes; chromenes; methylbenzofurans.

Abstract—A re-examination of the aerial part of *Ageratina glechonophylla* yielded spathulenol (1,6-dihydroxy-4(14)-eudesmene) as a natural product, six known chromenes, a mixture of three dimeric chromenes, four thymol derivatives and 3-(hydroxymethyl)-3-(acetoxymethyl)-and 3-(isobutyryloxymethyl)-6-methylbenzofuran were also identified in this plant.

INDRODUCTION

The genus *Ageratina* is a member of the Eupatorieae, a well-defined natural group found worldwide in hot and temperate zones, especially in America. In Chile, two species have been discovered: *Ageratina salvia* Colla and *A. glechonophylla* (Less) K. et R. Following the recent re-examination of *A. salvia* [1], the aerial parts of *A. glechonophylla* has now been subjected to further analysis.

RESULTS AND DISCUSSION

The aerial parts yielded spathulenol, a new natural product, 1,6-dihydroxy-4(14)-eudesmene (1) [2], the known chromenes **2a** [3], **2b** [3], **2c** [4], **2d** [5], **2e** [6] and **2f** [5], a mixture of dimeric chromenes **3a–c** [3] and thymol derivatives **4a** [7], **4b** [8], **4c** [8] and **4d** [9] as well as **4e–g**.

The compound **4e** was obtained as a viscous mass with the molecular formula $C_{10}H_{10}O_2$ (MS). The ^{1}H NMR spectrum (Table 1) revealed the presence of a trisubstituted benzene ring, $-CH_2OH$ and an aromatic methyl. The structure **4e** was assigned to this compound on the basis of COSY experiments. Compound **4f**, $C_{12}H_{12}O_3$ (M^+, *m/z* 204) has a ^{1}H NMR spectrum (Table 1) similar to that of **4g** differing in that there is a singlet at δ2.08 corresponding to an acetyl group. When **4e** was acetylated, the monoacetate **4f** was obtained. Compound **4g** has the $[M]^+$ at *m/z* 232, in accordance with formula $C_{14}H_{16}O_3$. Its ^{1}H NMR spectrum (Table 1) is analogous to those of **4e** and **4f** with the difference of an isobutyryloxy radical at δ1.16 [(*d*, *J* = 7 Hz), *m/z* 71].

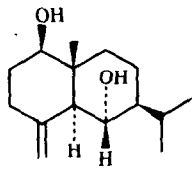
EXPERIMENTAL

^{1}H NMR spectra were taken in $CDCl_3$ at 200 MHz and MS were obtained using a direct inlet system at 70 eV. Plant material was collected in March 1985 on Cerro Grande, Chile and a voucher specimen No. 110 was lodged with the Herbarium of the Universidad de la Serena, Chile. This plant was earlier referred to as *Eupatorium glechonophyllum* Less.

Isolation of compounds. The dried aerial parts of *A. glechonophylla* (10 kg) were extracted with EtOH at room temp. for 20 days. The solvent was removed at red. pres. yielding a gummy residue (600 g) of which 200 g was taken and preadsorbed on 200 g silica gel (0.2–0.05 mesh) and chromatographed as reported previously [10] and then eluted with hexane and hexane–EtOAc mixtures (9:1, 4:1, 7:3, 3:2, 1:1, 2:3 and 1:9). The fractions with the same pattern in TLC were mixed and concd and the resulting substance (30 g) was rechromatographed over a silica gel column (500 g) and eluted with C_6H_6 and C_6H_6–EtOAc mixtures of increasing polarity, followed by prep. TLC (C_6H_6–EtOAc 9:1 and 4:1). The following compounds were isolated: **1** (5 mg), **2a** (30 mg), **2b** (15 mg), **2c** (5 mg), **2d** (80 mg), **2e** (200 mg), **2f** (250 mg), a mixture of **3a–c** (20 mg), **4a** (21 mg), **4b** (20 mg), **4c** (270 mg), **4d** (15 mg), **4e** (7 mg), **4f** (5 mg) and **4g** (4 mg).

Table 1. ^{1}H NMR spectra of benzofurans **4e–g** (200 MHz, $CDCl_3$, *J* in Hz)

H	4e	4f	4g
2	7.54 *br s*	7.60 *br s*	7.59 *br s*
4	7.53 *d* (8)	7.50 *d* (8)	7.48 *d* (8)
5	7.09 *d* (8)	7.10 *d* (8)	7.09 *d* (8)
7	7.29 *br s*	7.30 *br s*	7.29 *br s*
8	2.47 *br s*	2.47 *br s*	2.47 *br s*
9	4.81 *d* (10)	5.23 *br s*	5.23 *br s*
OAc		2.08 *br s*	
$OCOCH(Me)_2$			2.57 *hept* (7)
$OCOCH(\underline{Me})_2$			1.16 *d* (7)



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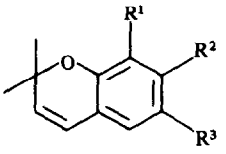
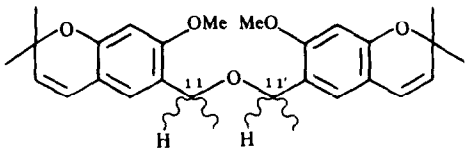
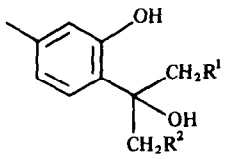


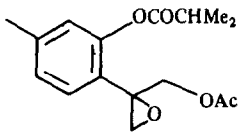
	2a	2b	2c	2d	2e	2f
R^1	H	H	H	H	OMe	H
R^2	OMe	OMe	OMe	OMe	H	OH
R^3	CH(OH)Me	CH(OMe)Me	CH(OEt)Me	Ac	Ac	Ac



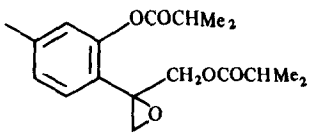
3a	11-α-Me	11'-β-Me
3b	11-β-Me	11'-β-Me
3c	11-β-Me	11'-α-Me



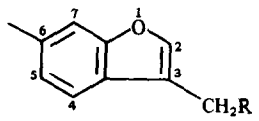
	4a	4b
R^1	$OCOCHMe_2$	$OCOCHMe_2$
R^2	OH	OAc



4c



4d



	4e	4f	4g
R	OH	OAc	$OCOCHMe_2$

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1β,6α-*Dihydroxy*-4(14)-*eudesmene* (**1**). Colourless oil, MS *m/z* (rel. int.): 238 $[M]^+$ (2), 220 $[M-18]^+$ (8), 202 (5), 195 (3), 177 (16); ^{1}H NMR: δ 5.01 (1H, *d*, *J* = 1 Hz), 4.74 (1H, *d*, *J* = 1 Hz), 3.71 (1H, *t*, *J* = 10 Hz), 3.42 (1H, *dd*, *J* = 11, 4.5 Hz), 0.95 (3H, *d*, *J* = 7 Hz), 0.87 (3H, *d*, *J* = 7 Hz), 0.70 (3H, *s*).

3-(*hydroxymethyl*)-6-*Methylbenzofuran* (**4e**). Colourless oil, MS *m/z* (rel. int.): 162 $[M]^+$ (100), 161 (41), 149 (29), 147 (10), 146 (10), 145 (61), 133 (24), 105 (48); ^{1}H NMR: see Table 1.

Acetylation of **4e**. 6 mg were dissolved in acetic acid and pyridine and left at room temp. overnight, recovered in the usual way giving a mono-acetate with ^{1}H NMR and MS identical to those of **4f**.

3-(*acetoxymethyl*)-6-*Methylbenzofuran* (**4f**). Colourless oil, MS *m/z* (rel. int.): 204 $[M]^+$ (11), 167 (40), 162 (26), 149 (100), 145 (23), 71 (52); ^{1}H NMR: see Table 1.

3-(*isobutyryloxymethyl*)-6-*Methylbenzofuran* (**4g**). Colourless oil, MS *m/z* (rel. int.): 232 $[M]^+$ (18), 217 (3), 162 (49), 145 (59), 115 (35), 91 (20), 71 (44), 23 (100); ^{1}H NMR: see Table 1.

REFERENCES

1. González, A. G., Barrera, J. B., Díaz, J. G., Rodríguez, E. M., Yanes, A. C., Rauter, P. and Pozo, J. (1988) *Phytochemistry* (in press).
2. Itokawa, H., Matsumoto, H. and Mihashi, S. (1983) *Chem. Letters* 1253.
3. Fang, N., Yu, S. and Mabry, T. J. (1988) *Phytochemistry* **27**, 1902.
4. Becerra, J., Silva, M., Monache, D. G., Monache, F. D. and Botta, M. (1983) *Rev. Latinoam. Quim.* **14**, 92.
5. Proksch, P. and Clark, C. (1987) *Phytochemistry* **26**, 171.
6. Bohlmann, F, Jakupovic, J. and Lonitz, M. (1977) *Chem. Ber.* **110**, 301.

7. González, A. G., Barrera, J. B., Rozas, F. E., Hernández. C. Y., Espiñeira, H. and Nathan, P. J. (1983) *Phytochemistry* **22**, 2889.
8. Martínez, V. M., Sánchez, F. A. and Nathan, J. P. (1987) *Phytochemistry* **26**, 2577.
9. Bohlmann, F., Kramp, N., Gupta, K. R., King, M. R. and Robinson, H. (1981) *Phytochemistry* **20**, 2375.
10. González, A. G., Barrera, J. B., Hernández, C. Y., Rozas, F. E. and Domínguez, X. A. (1985) *Phytochemistry* **24**, 1847.

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8-PRENYLLUTEONE, A PRENYLATED ISOFLAVONE FROM *ERYTHRINA ERIOTRIOCHA*

AUGUSTIN E. NKENGFACK,† DALE R. SANSON, Z. TANEE FOMUM‡* and MICHAEL S. TEMPESTA*

Department of Chemistry, University of Missouri, Columbia, MO 65211, U.S.A.; ‡Department of Organic Chemistry, University of Yaounde, B.P. 812, Yaounde, Cameroon

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Key Word Index—*Erythrina eriotriocha*; Leguminosae; stem bark; 8-prenylluteone; 6,8-diprenylorobol; auriculasin; scandenone; cudraisoflavone A.

Abstract—The new isoflavone, 8-prenylluteone, has been isolated from the stem bark of *Erythrina eriotriocha* and its structure established by spectroscopic means and chemical transformations. The previously known prenylated isoflavones 6,8-diprenylorobol, auriculasin and scandenone have been also isolated. Cudraisoflavone-A has been shown to be identical with auriculasin.

INTRODUCTION

The genus *Erythrina* is widely known for its physiologically active alkaloids [1]. In recent years, however, there has been an increase in research efforts on the non-alkaloidal secondary metabolites, especially flavanoids and pterocarpans, of this genus [2–4]. As part of our investigation on Cameroonian medicinal plants in general and on the genus *Erythrina* in particular, we have continued [4] our study by investigating the constituents of *E. eriotriocha*. In this paper, we describe the isolation and structural determination of a new isoflavone (8-prenylluteone, **1**) along with three previously known isoflavones 6,8-diprenylorobol **4**, scandenone **5** and auriculasin **6**. The ^{13}C NMR data of **4**–**6** are reported for the first time. The structure of cudraisoflavone A **7** is incorrect, and is shown to be identical to auriculasin **6**.

RESULTS AND DISCUSSION

8-Prenylluteone (**1**), $C_{25}H_{26}O_6$ ([M^+] 422.1787, Calcd 422.1729), was isolated from the chloroform extract of the stem bark of *Erythrina eriotriocha* as described in the Experimental. The IR spectrum of (**1**) exhibited absorptions at 3415 (free OH), 3373 (chelated OH) and 1640 cm^{-1} (conj. carbonyl). The downfield signal in ^1H NMR at δ12.50 confirmed the presence of an intramolecular hydrogen bonded group at the C-5 position, while acetylation of **1** with acetic anhydride–pyridine yielded a tetraacetate (**2**), which did not respond to iron (III) test. Thus, **1** contains four hydroxyl groups (three free hydroxyls and one chelated hydroxyl). The signal in the ^1H NMR spectrum observed at δ7.98 is assigned to the C-2 proton of an isoflavone. This skeleton was supported by its UV spectrum (see Experimental) and by the following colour tests; positive to $FeCl_3$ (greenish-brown) and negative to Mg–HCl. The presence of two γ,γ-dimethylallyl (=prenyl) groups was shown in the ^1H NMR spectrum by four methyl signals (δ1.71, 1.74, 1.80 and 1.81), two 2H doublets (δ3.43 and 3.46; J = 7.1 Hz), Ar–CH_2–CH=C and two 1H triplets at δ5.18 and 5.22, J = 7.1 Hz, Ar–CH_2–CH=C). Furthermore, a typical ABX system at δ6.44 (*dd*, J = 7.2, 2.2 Hz) 6.52 (*d*, J = 2.2 Hz) and 6.98 (*d*, J = 7.2 Hz) showed the presence of three aromatic protons in B ring. The lack of further aromatic signals suggested that the H-6 and H-8 protons are absent [5]. In the EI mass spectrum, the molecular ion was detected at m/z 422 and other prominent fragments are shown in Fig. 1. The fragment ion peaks at m/z 288 and 134 caused by usual retro-Diels–Alder cleavage revealed information about the structure of (**1**). The ion m/z 288 resulted from the A ring and showed that this moiety possessed two prenyl groups at C-6 and C-8 in addition to two hydroxyls at C-5 and C-7. On the other

Part 12 in the series '*Erythrina* Studies'. For part 11 see ref. [4].
†On leave from the University of Yaounde.
*Authors to whom correspondence should be addressed.