Phytochemistry, Vol. 27, No. 9, pp. 2987 2988, 1988.
Printed in Great Britain.

0031 9422/88 $3.00+0.00

GUAIANOLIDES FROM *BACCHARIS SALICINA*

FELIX J. PARODI and NIKOLAUS H. FISCHER*

Department of Chemistry, Louisiana State University, Baton Rouge, LA 70803, U.S.A.

(*Received* 25 *November* 1987)

Key Word Index—*Baccharis salicina*; Asteraceae; sesquiterpene lactones; guaianolides; centaureidin.

Abstract—Chemical analysis of *Baccharis salicina* afforded two new guaianolides, bacchariolides A and B, and the known flavone centaureidin. Their structures were elucidated by spectroscopic methods.

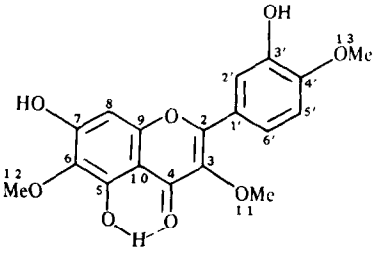
INTRODUCTION

In continuation of our search for biologically active sesquiterpene lactones, we have chemically analysed *Baccharis salicina* (Asteraceae) from Texas. Besides the antitumour-active flavone centaureidin (**1**) [1], two new guaianolides, bacchariolide A (**2**) and B (**3**), were isolated and their structures elucidated by spectroscopic methods.

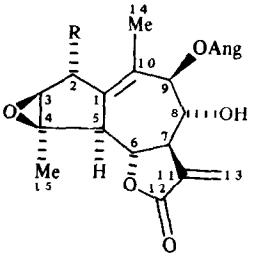
RESULTS AND DISCUSSION

Chromatographic fractionation of a crude extract of *B. salicina* yielded compounds **1**–**3**. The structure of the known flavone centaureidin (**1**) was determined by comparison with spectroscopic data reported in the literature [2]. The mass spectral fragmentation was very similar to that of its isomer, jaceidin [3].

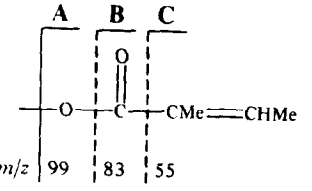
Bacchariolide A (**2**) is a gum, with a molecular ion at $m/z = 376$ which together with the ^{1}H and ^{13}C NMR data was in agreement with the molecular formula $C_{20}H_{24}O_7$. Additional MS peaks at $m/z = 276$ $[M-(A+1)]^+$, m/z 83 $[B]^+$, and m/z 55 $[C]^+$ as well as ^{1}H NMR resonances at δ1.98, 2.04, 6.23 and ^{13}C NMR peaks at δ15.9 and 20.5 were diagnostic of an angelate moiety [5]. The ^{1}H COSY NMR spectrum of **2** showed two series of coupled protons: H-2 to H-3 and H-5 to H-9, with H-7 being coupled to a three-proton multiplet at δ6.23 (H-13a, H-13b, H-3'), which exhibited heteronuclear correlation with olefinic carbons at δ122.7 and 141.2, indicating a 8α-hydroxy-*trans*-α-methylene γ-lactone [6]. IR absorptions at 3460 cm^{-1} (hydroxyl), 1769 cm^{-1} (γ-lactone) and 1717 cm^{-1} (ester) as well as long-range couplings between the C-10 methyl at δ1.81 and H-2 and H-5, provided by a COSY spectrum, suggested a highly substituted 12,6-lactonized guaianolide. NOE difference spectroscopy indicated effects between H-5, H-7, and H-9; H-6 and H-8; C-10-Me and H-2 as well as C-4-Me and H-3. These observations together with coupling constants (Table 1) allowed the establishment of the stereochemistry at all chiral centres, supporting a stereostructure represented by **2**. All ^{1}H and ^{13}C NMR resonance assignments given in Tables 1 and 2 were based on DEPT and 2D Homo- and Heteronuclear Correlation Spectroscopy [7, 8].



1



2 R = OH
3 R = H



Bacchariolide B (**3**) is a gum, which showed in the MS a molecular ion at m/z 360. Additional MS peaks at m/z 83 $[B]^+$ and 55 $[C]^+$ and ^{1}H NMR resonances at δ1.97, 2.02 and 6.22 indicated an angelate moiety. The 400 MHz ^{1}H NMR spectrum was very similar to that of lactone **2** but the signal at δ4.72 (H-2) in **2** was missing in lactone **3**, suggesting the absence of a hydroxyl group at C-2 in **3**. Instead, two one-proton absorptions at δ2.48 and 2.75 with a large geminal coupling constant (17.7 Hz) for H-2α and H-2β were found. The ^{1}H NMR spectrum was as-

*Author to whom correspondence should be addressed.

Table 1. ^{1}H NMR spectral data*† of baccharilides A (**2**) and B (**3**)

H	2	3
2α		2.48 *d*
2β	4.72 *br s*	2.75 *br d*
3	3.56 *br s*	3.40 *br s*
5	3.35 *br d*	3.18 *br d*
6	3.58 *dd*	3.62 *dd*
7	3.08 *ddd*	3.03 *ddd*
8	3.81 *dd*	3.78 *ddd*
9	5.35 *d*	5.40 *d*
13a	6.23	6.22
13b	6.23	6.22
14	1.81 *br s*	1.60 *s*
15	1.67 *s*	1.70 *s*
3′	6.23	6.22
4′	1.98 *dq*	1.97 *dq*
5′	2.04 *dq*	2.02 *dq*
8-OH	2.56 *br d*	2.41 *d*
2-OH	2.20 *br s*	—

*400 MHz, $CDCl_3$, ambient temperature, TMS as internal standard.

†*J* (Hz): **2**: 5, 6 = 6, 5 = 10.8; 6, 7 = 7, 6 = 10.5; 7, 8 = 8, 7 = 10.0; 8, 9 = 9, 8 = 9.7; 5′, 3′ = 7.2; 4′, 5′ = 5′, 4′ = 1.5; 4′, 3′ = 1.5; 7, 13 = 3.0. **3**: 5, 6 = 6, 5 = 10.7; 6, 7 = 7, 6 = 10.5; 7, 8 = 8, 7 = 10.2; 8, OH = 3.4; 8,9 = 9, 8 = 9.8; 4′,3′ = 1.4; 4′,5′ = 5′, 4′ = 1.5; 5′,3′ = 7.3; 2α, 2β = 17.7.

Table 2. ^{13}C NMR spectral data of centaureidin (**1**) and baccharilide A (**2**)

C	1*	C	2†
1	—	1	136.9 *s*‡
2	157.4 *s*	2	72.6 *s*
3	137.6 *s*	3	66.0 *d*
4	178.2 *s*	4	65.5 *s*
5	152.3 *s*	5	51.1 *d*
6	131.1 *s*	6	77.5 *d*
7	155.3 *s*	7	55.9 *d*
8	93.9 *d*	8	69.3 *d*
9	151.5 *s*	9	76.7 *d*
10	104.6 *s*	10	136.3 *s*‡
11	59.9 *q*	11	138.0 *s*‡
12	59.7 *q*	12	168.6 *s*
13	55.6 *q*	13	122.7 *t*
1′	122.3 *s*	14	14.7 *q*
2′	114.9 *d*	15	18.8 *q*
3′	146.3 *s*	1′	166.6 *s*
4′	150.2 *s*	2′	126.5 *s*
5′	111.9 *d*	3′	141.2 *d*
6′	120.3 *d*	4′	20.5 *q*
		5′	15.9 *q*

*DMS-d_6 (298 K). 100.61 MHz; established by comparison with pectolinarigenin and quercetin 3,4′-dimethylether [4].

†$CDCl_3$.

‡Interchangeable.

signed by comparison with the spectral data of **2** and on the basis of decoupling experiments. This led to the same stereochemistry as in compound **2** at all chiral centers of lactone **3**.

EXPERIMENTAL

Baccharis salicina T. & G. was collected on 18 April 1981 along highway 357, 0.2 miles west of intersection with highway 286 near Corpus Christi, Texas (Malcolm–Vargas; voucher deposited at the Herbarium of Louisiana State University). The air-dried plant material (670 g) was extracted and worked-up as described in ref. [9], providing 3.6 of the crude terpenoid extract. Column chromatography of this crude in silica gel, first with CH_2Cl_2, then with a gradient CH_2Cl_2–Me_2CO, and finally with Me_2CO provided 20 fractions of 300 ml each. Fraction 2 yielded centaureidin (**1**) (25 mg). Fraction 12 was purified by TLC on silica gel with CH_2Cl_2 affording **3** (2 mg). Fraction 14 was chromatographed by prep. TLC over silica gel using CH_2Cl_2–Me_2CO (1:6) yielding **2** (12 mg).

Centaureidin (**1**), $C_{18}H_{16}O_8$, EIMS *m/z* (rel int): 360 $[M]^+$ (30.5), 345 $[M-Me]^+$ (18.2), 342 $[M-H_2O]^+$ (7.2), 327 $[M-Me-H_2O]^+$ (6.4), 317 $[M-MeCO]^+$ (27.8), 302 $[M-MeCO-Me]^+$ (7.9), 299 $[M-MeCO-H_2O]^+$ (22.1), 274 $[M-MeCO-Me-CO]^+$ (9.7), 259 (8.5), 246 $[M-MeCO-Me-2CO]^+$ (7.2), 151 (33.6), 135 (35.4), 123 (31.4), 108 (23.7), 95 (22.2), 77 (25.6), 69 (100.0). 400 MHz ^{1}H NMR; $(CD_3)_2CO$: H-8 δ6.56 *d*, H-2′ δ7.65 *d*, H-5′ δ7.12 *d*, H-6′ δ7.68 *dd*, 2 OMe: δ3.89 *s* (3H), δ3.94 (3H).

Baccharilide A (**2**). $C_{20}H_{24}O_7$, HRMS (FAB, probe) 70 eV *m/z* (rel int): 376.1313 $[M]^+$ (0.9), (calc. for $C_{20}H_{24}O_7$): 376.1622), 277.1965 $[M-A]^+$ (51.8), 259.1582 $[M-A-H_2O]^+$ (17.0). EIMS *m/z* (rel int): 376 $[M]^+$ (0.1), 276 $[M-(A+1)]^+$ (1.4), 258 $[M-(A+1)-H_2O]^+$, 83 $[B]^+$ (100), 55 $[C]^+$ (65.4). IR ν_{max}^{neat} cm^{-1}: 3460 (OH), 1769 (γ-lactone), 1717 (ester).

Baccharilide B (**3**). $C_{20}H_{24}O_6$ EIMS *m/z* (rel int): 360 $[M]^+$ (0.2), 242 $[M-(A+1)-H_2O]^+$ (0.1, 214 [242 − CO] (0.7), 83 $[B]^+$ (100), 55 $[C]^+$ (44.7). IR ν_{max}^{neat} cm^{-1}: 3418 (OH), 1769 (γ-lactone), 1717 (ester).

Acknowledgements– The authors are grateful to the U.S.–Spain Joint Committee for Scientific and Technological Cooperation (Project No. CCB-8409023) for financial support. Purchase of 100 and 400 MHz NMR spectrometers was made possible by NIH shared Instrumentation Grant 1 S10RR02459-01. We thank Helga D. Fischer for technical assistance.

REFERENCES

1. Kupchan, S. M. and Bauerschmidt, E. (1971) *Phytochemistry* **10**, 664.
2. Bohlmann, F. and Zdero, C. (1967) *Tetrahedron Letters* **33**, 3239.
3. Bowie, J. H. and Cameron, D. W. (1966) *Aust. J. Chem.* **19**, 1627.
4. Harborne, J. B. and Mabry, T. J. (1982) *The Flavonoids: Advances in Research*. Chapman & Hall, London.
5. Budesinsky, M. and Saman, D. (1987) *Collect. Czech. Chem. Commun.* **52**, 453.
6. Yoshioka, H., Mabry, T. J., Irwin, M. A. and Geissman, T. A. (1971) *Tetrahedron* **27**, 3317.
7. Morris, G. A. (1986) *Magn. Reson. Chem.* **24**, 371.
8. Benn, R. and Günther, H. (1983) *Angew. Chem. Int. Ed. Eng.* **22**, 350.
9. Fischer, N. H., Wiley, R. A., Lin, H. N., Karimian, K. and Politz, S. M. (1975) *Phytochemistry* **14**, 2241.