Phytochemistry, Vol. 22, No. 12, pp. 2863–2864, 1983.
Printed in Great Britain.

0031-9422/83 \$3.00 + 0.00

FURTHER HIRSUTINOLIDES FROM *VERNONIA POLYANTHES*

Ferdinand Bohlmann, Christa Zdero, Robert M. King* and Harold Robinson*

Institute for Organic Chemistry, Technical University of Berlin, D-1000 Berlin 12, West Germany; *Smithsonian Institution, Dept. of Botany, Washington D.C. 20560, U.S.A.

(*Received* 28 *April* 1983)

Key Word Index—*Vernonia polyanthes*; Compositae; sesquiterpene lactones; hirsutinolides; vernopolyanthofuran derivative.

Abstract—A reinvestigation of the aerial parts of *Vernonia polyanthes* afforded two further hirsutinolides and a dehydro derivative of vernopolyanthofuran.

A reinvestigation of the polar fractions of the *Vernonia polyanthes* Less. afforded the two epimeric hirsutinolides **1** and **2**, the methacrylate **3** [1], vernopolyanthofuran [1] as well as the dehydro derivative **5**.

The structures of **1** and **2**, which could not be separated even by HPLC, followed from the molecular formula and the ^{1}H NMR spectral data (Table 1), which were close to those of the epimeric mixture of 8α,10α-diacetoxy-1-methoxyhirsutinolide-13-*O*-acetates [2]. As clearly followed from the ^{1}H NMR spectrum one of the acetate residues was replaced by a methacrylate residue. As the concentration of **1** and **2** was slightly different and as **1** could be enriched by HPLC, all signals could be assigned from the ^{1}H NMR spectrum of the mixture. As the H-8 signal was slightly shifted down field, if compared with the shift of the acetates [2], the methacrylate obviously was at C-8, thus leading to the structures **1** and **2**. The differences in the chemical shifts of H-9α allowed the assignment of the stereochemistry at C-1. The 1-methoxy group caused a clear down field shift of the H-9α signal obviously due to a deshielding effect, which was in good agreement if models were inspected. As shown with other hirsutinolides [2, 3] heating of the mixture of **1** and **2** with acetic anhydride afforded a single lactone, the methacrylate **4**, which was identical with the lactone obtained previously by acetylation and elimination of methanol from the corresponding methyl ethers with a free 10-hydroxy group [3]. As the acid catalysed methanol addition only afforded one epimer [3], the epimers **1** and **2** obviously were no artifacts. The hirsutinolide **3** was already isolated previously from the same species [1]. As mentioned previously [1] the absolute configuration of the hirsutinolides are changed. The structure of **5** followed from the molecular formula and the ^{1}H NMR spectrum, which was in part close to that of vernopolyanthofuran [1]. However, the presence of an additional double bond could be deduced from the narrowly split triplet at δ6.59, which was coupled with an olefinic methyl group displaying a broad singlet at δ1.92. Spin decoupling allowed the assignment of all signals though those of H-4 and H-5 were not first order. Spin simulation, however, gave exactly the observed picture. The stereochemistry of the 6,7-double bond followed from the chemical shift of H-6 while the absolute configuration at C-3 was not determined. It may be of interest that **5** showed in the MS in part fragments identical with those of the corresponding 6,7-dihydro derivative [1]. Most likely $m/z = 138$ was formed via **6** by a McLafferty fragmentation (see Scheme 1).

EXPERIMENTAL

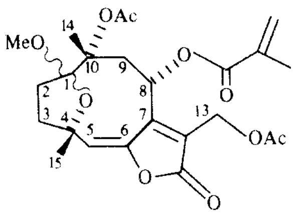
The aerial parts (1 kg, collected in the province Bahia, Brazil, voucher RMK 8033) were extracted with Et$_2$O–petrol, 1:1, and the polar CC fractions (Et$_2$O and Et$_2$O–MeOH, 20:1) were separated by TLC (silica gel, Et$_2$O–petrol, 3:1) affording (increasing polarity) 10 mg vernopolyanthofuran, 8 mg **5**, 10 mg of a mixture of **1** and **2** (*ca* 7:8) and 10 mg **3**. HPLC of the mixture of **1** and **2** (RP 8, MeOH–H$_2$O, 13:7) only led to a slight enrichment of **1** if the first part of the fraction was taken separately.

10α-Acetoxy-8α-methacryloyloxy-1α- and 1β-methoxyhirsutinolide-13-O-acetate (**1** and **2**). Colourless oil, IR $\nu_{\max}^{\mathrm{CCl_4}}$ cm^{-1}: 1780 (γ-lactone), 1745 (OAc), 1720, 1640 (C=CCO$_2$R); MS *m*/*z* (rel. int.): 478.183 [M]$^+$ (5) (C$_{24}$H$_{30}$O$_{10}$), 447 [M − OMe]$^+$ (11), 392 [M − RCO$_2$H]$^+$ (1), 388 [447 − OAc]$^+$ (3), 387 [447 − HOAc]$^+$ (1), 69 [RCO]$^+$ (100); 10 mg **1** and **2** were heated for 2 h in 0.5 ml Ac$_2$O at 70°. After evaporation TLC (silica gel, Et$_2$O) afforded 8 mg **4**, identical with the compound obtained

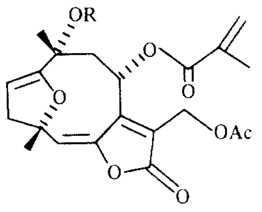
Table 1. ^{1}H NMR spectral data of compounds **1** and **2** (270 MHz, TMS as int. standard)

	CDCl$_3$		C$_6$D$_6$/70°	
	1	**2**	**1**	**2**
H-2,3	2.7–2.5 *m*		2.40 *m*	
H-5	6.08 *s*	6.07 *s*	5.73 *s*	
H-8	5.51 *br t*	5.53 *br t*	5.66 *br t*	5.68 *br t*
H-9α	2.7–2.5 *m*		2.90 *dd*	2.63 *dd*
H-9β	2.32 *dd*	2.30 *dd*	2.56 *dd*	
H-13	4.86 *s*	4.85 *s*	5.02 *d*	5.05 *d*
H-13′			4.91 *d*	4.93 *d*
H-14	1.57 *s*	1.53 *s*	1.26 *s*	1.29 *s*
H-15	1.35 *br s*	1.30 *br s*	1.23 *s*	1.24 *s*
OCOR	6.18 *br s*		6.11 *br s*	
	5.71 *dq*		5.30 *dq*	
	1.94 *br s*		1.83 *br s*	
OMe	3.28 *s*	3.27 *s*	3.33 *s*	3.23 *s*
OAc	2.05 *s*	2.04 *s*	1.61 *s*	1.70 *s*
	1.94 *s*	1.94 *s*	1.69 *s*	1.74 *s*

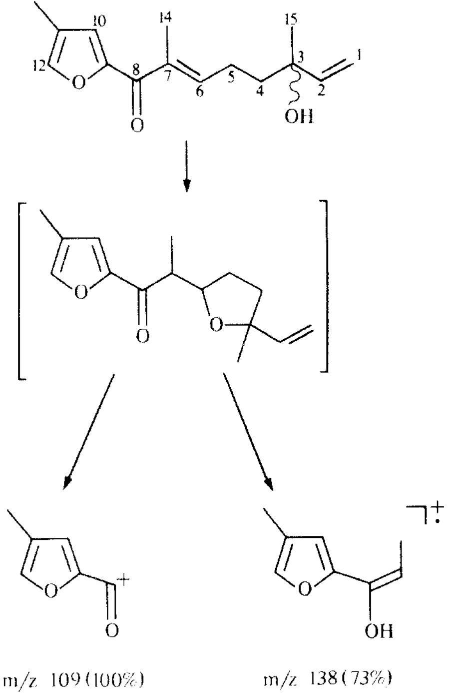
J (Hz): 8, 9α = 3; 8, 9β = 3.7; 9α, 9β = 15; $3'_1, 3'_2 = 3'_2, 4' = 1$.



1 1αOMe
2 1βOMe



3 R = H
4 R = Ac



5 m/z 248

6

Scheme 1.

previously from **3** [3]. $[\alpha]_D^{\lambda} = +20$ ($CHCl_3$; *c* 0.78).

6,7*E-Dehydrovernopolyanthofuran* (**5**). Colourless oil: IR $\nu_{max}^{CCl_4}$ cm^{-1}: 3600 (OH), 1640 (C=CCOC=C); MS *m/z* (rel. int.): 248.141 $[M]^+$ (2) ($C_{15}H_{20}O_3$), 233 $[M - Me]^+$ (1), 230 $[M - H_2O]^+$ (4.5), 177 $[M - MeC(OH)CH{=}CH_2]^+$, 138 $[C_8H_{10}O_2, \mathbf{8}]^+$ (73), 109 $[C_6H_5O_2, \mathbf{7}]^+$ (100), 71 $[MeC(OH)CH{=}CH_2]^+$ (48), 53 $[71 - H_2O]^+$ (61); ^1H NMR ($CDCl_3$): δ5.12 (*dd*, H-1c), 5.26 (*dd*, H-1t), 5.94 (*dd*, H-2), 1.73 (*ddd*, H-4), 1.66 (*ddd*, H-4′), 2.35 (*dddq*, H-5), 2.29 (*dddq*, H-5′), 6.59 (*tq*, H-6), 6.90 (*br s*, H-10), 7.37 (*dq*, H-12), 2.07 (*br s*, H-13), 1.92 (*br s*, H-14), 1.33 (*s*, H-15), (*J* (Hz): 1c, 1t = 1.3; 1c, 2 = 11; 1t, 2 = 17.5; 4, 4′ = 14; 4, 5 = 6.5; 4, 5′ = 9; 4′, 5 = 9; 4′, 5′ = 6.5; 5, 5′ = 15; 5, 6 = 5′, 6 = 7; 5, 14 = 0.5; 6, 14 = 1.5; 10, 12 = 10, 13 ~ 0.7; 12, 13 = 1.

$$[\alpha]_{24}^{\lambda} = \frac{589 \quad 578 \quad 546 \quad 436}{-2.7 \quad -3.1 \quad -3.4 \quad -7.1} \; (CHCl_3;\ c\ 0.59).$$

Acknowledgements—We thank Drs. Scott A. Mori and P. Alvim, Herbario Centro de Pesquisas do Cacau at Itabanu, Bahia, Brazil, for their help during plant collection and the Deutsche Forschungsgemeinschaft for financial support.

REFERENCES

1. Bohlmann, F., Jakupovic, J., Gupta, R. K., King, R. M. and Robinson, H. (1981) *Phytochemistry* **20**, 473.
2. Bohlmann, F., Zdero, C., King, R. M. and Robinson, H. (1979) *Phytochemistry* **18**, 987.
3. Bohlmann, F., Brindöpke, G. and Rastogi, R. C. (1978) *Phytochemistry* **17**, 475.