Phytochemistry, Vol. 21, No. 7, pp. 1693–1695, 1982.
Printed in Great Britain.

0031-9422/82/071693-03$03.00/0

THREE DITERPENES FROM *CONYZA PODOCEPHALA**

FERDINAND BOHLMANN and PETER WEGNER

Institute for Organic Chemistry, Technical University of Berlin, D-1000 Berlin 12, West Germany

(*Received* 9 *September* 1981)

Key Word Index—*Conyza podocephala*; Compositae; diterpenes; clerodane derivatives; furan diterpenes; resorcinol derivatives.

Abstract—The investigation of *Conyza podocephala* afforded, in addition to known compounds, two clerodane derivatives and a dihydroxyfarnesyl methylfuran. Furthermore two new resorcinol derivatives were isolated. The structures were elucidated by spectroscopic methods and by chemical transformations. The chemotaxonomic situation within the genus is discussed briefly.

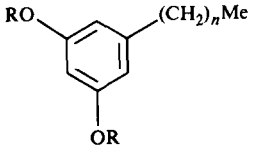
INTRODUCTION

From the genus *Conyza* (Compositae, tribe Astereae), ten species have so far been investigated chemically. Typical acetylenes are present in most [1, 2], but in addition, triterpenes [3, 4], flavones [5], diterpenes [6–8] and from one species coumarins have been reported [1]. We have now studied the constituents of *Conyza podocephala* DC. a common weed in South Africa. Their structural elucidation will be discussed in this paper.

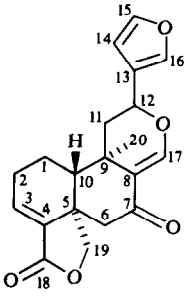
RESULTS AND DISCUSSION

The aerial parts of *C. podocephala* afforded germacrene D, bicyclogermacrene, phytol, the resorcinol derivatives **1a–3a** as well as the diterpenes **4**, **5** and **7**. The structures of **2a** and **3a**, which were inseparable followed from the spectroscopic data and those of the corresponding acetates. **1a** and the lower homologues with $n = 12$ and 13 have been isolated from a *Baccharis* species [9], while **1a** was present in a member of the Proteaceae [10]. The spectral data were more or less identical with those of **2a** and **3a**. The ^{1}H NMR spectra of **7**, of the corresponding diacetate **8** and of the dialdehyde **9**, obtained by manganese dioxide oxidation, allowed the assignment of the structure (Table 1). The spectrum of **9** clearly showed that the oxygen functions had to be placed at C-18 and C-19 since the signals of H-16 and H-17 were unchanged, when compared with the spectrum of **7**. The chemical shifts of H-6, H-10, H-18 and H-19 further showed that the three double bonds had the E-configuration. The typical downfield signals at δ 7.36, 7.22 and 6.28 indicated the presence of a β-substituted furan. The ^{1}H NMR data in part were similar to those of **10**, an acid which was isolated from a *Centipeda* species [11]. We have named **7** conypododiol. The structure of **4**, $C_{20}H_{20}O_5$, followed from the ^{1}H NMR spectrum (Table 2) and spin decoupling. Again the typical downfield signals at δ 7.51, 7.45 and 6.43 clearly indicated the presence of a β-substituted furan, while the similarity with hautriwaic acid lactone, which is present in *Conyza ivaefolia* [7], was shown by the characteristic signals at δ 6.81, 4.18 and 4.15. Spin decoupling led to the

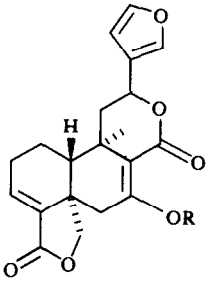
*Part 420 in the series "Naturally Occurring Terpene Derivatives". For Part 419 see Bohlmann, F. and Gupta, R. K. (1982) *Phytochemistry* **21**, 1799.



	1a	1b	2a	2b	3a	3b
R	H	Ac	H	Ac	H	Ac
n	14		15		16	

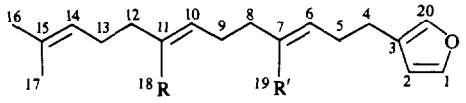


4



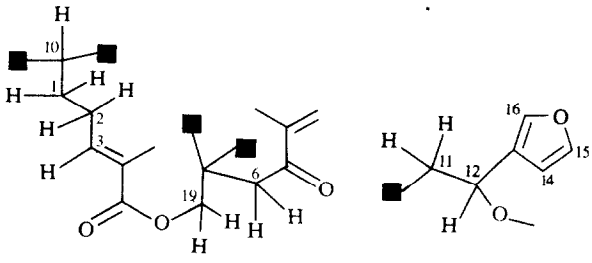
5 R = H

6 R = Ac



	7	8	9	10
R	CH_2OH	CH_2OAc	CHO	CO_2H
R′	CH_2OH	CH_2OAc	CHO	Me

sequences **A** and **B** (numbering as in the final structure):



A **B**

Table 1. ^{1}H NMR spectral data of compounds **7–9** (400 MHz, $CDCl_3$ TMS as int. standard)

	7	8	9
H-1	7.36*br s*	7.35*br s*	7.35*br s*
H-2	6.28*br s*	6.27*br s*	6.26*br s*
H-4	2.49*br t*	2.49*br t*	2.64*br t*
H-5	2.34*br dt*	2.40*br dt*	2.84*br dt*
H-7	5.35*br t*	5.45*br t*	6.41*br t*
H-8	2.42*br t*	2.3*m*	2.35*br t*
H-9	2.22*br t*	2.1*m*	2.64*br dt*
H-10	5.31*br t*	5.39*br t*	6.37*br t*
H-12 }	2.13*br s*	2.08*m*	2.18*br t*
H-13 }			2.06*br dt*
H-14	5.12*br t*	5.09*br t*	5.06*br t*
H-16	1.69*br s*	1.69*br s*	1.68*br s*
H-17	1.61*br s*	1.61*br s*	1.61*br s*
H-18	4.09*br s*	4.57*br s*	10.01*s*
H-19	4.12*br s*	4.59*br s*	10.05*s*
H-20	7.22*br s*	7.22*br s*	7.22*br s*
OAc	—	2.06*s*	—
		2.05*s*	

J(Hz):4,5 = 5,6 = 8,9 = 9,10 = 12,13 = 13,14 ~ 7.

The chemical shift of H-12 required an oxygen function at C-12, which, following the typical couplings of H-11, could be present as a lactone ring. However, the IR spectrum displayed a band at 1780 cm^{-1}, due to the 18,19-lactone, and bands at 1680 and 1590 cm^{-1}, indicating the presence of a vinylogous lactone. This was in agreement with a pair of signals at δ 2.88 and 2.28, the latter showing a *W*-coupling with H-19, and a downfield singlet at 7.42. The most likely structure for the diterpene therefore was **4**. The ^{13}C NMR spectrum also supported this structure. The furan carbons were readily assigned due to long-range couplings visible in the off-resonance spectrum. As the optical rotation was similar to that of hautriwaic acid lactone, the same absolute configuration is presumably present in **4**, which we have named conycephaloide.

The molecular formula of **5** indicated an additional oxygen compared to **4**. This must be present as a chelated hydroxyl group, since in the ^{1}H NMR spectrum a downfield singlet at δ 12.98 was visible. Consequently acetylation afforded an acetate. As in the spectrum of **5** the downfield signal at H-17, present in that of **4**, was missing, the position of the hydroxyl could be at either C-8 or C-17. Accordingly a keto group at C-8 or C-17 and a 7, 8 or a 8, 17-double bond could be assumed. Since in the ^{1}H NMR spectrum of **5** and **6** the H-12 signal was shifted downfield, when compared with the shift of H-12 in the spectrum of **4**, it is reasonable to place the hydroxyl at C-8 and the carbonyl group at C-17. All the other signals were similar to those of **4**; in particular, the coupling pattern was unchanged, indicating that the stereochemistry was the same in both diterpenes. Somewhat surprisingly, however, **5** existed completely in the enol form, since no trace of the expected H-8 singlet of a keto tautomer was visible in the ^{1}H NMR spectrum.

The chemistry of *Conyza podocephala* differs considerably from that of *C. obscura* DC. [1] which can be confused morphologically with the former [12]. The isolation of the diterpenes **4**, **5** and **7** from a *Conyza* species may be of taxonomic interest, as these compounds obviously are closely related to the diterpenes isolated from a *Centipeda* species [11]. As pointed out previously [11], the genera *Centipeda* and *Cotula* are obviously related in their chemistry. These three genera together seem to be intermediate between the tribes Astereae and Anthemideae in terms of their chemistry and their morphological features also suggest their classification together in a transitional position between these two tribes [13].

EXPERIMENTAL

The air-dried plant material, collected in February 1981 in Transvaal (voucher 81/176, deposited in the Botanic Research Institute, Pretoria), was extracted with Et_2O–petrol (1:2) and the resulting extracts were separated first by CC (Si gel) and further by repeated TLC (Si gel). Known compounds were identified by comparing the ^{1}H NMR spectra with those of authentic material. The roots (20 g) afforded 5 mg squalene and the aerial parts (220 g) 120 mg germacrene D, 80 mg bicyclogermacrene, 100 mg phytol, 60 mg **1a–3a** (*ca* 3:1:6), 120 mg **4** (CH_2Cl_2–C_6H_6–Et_2O, 1:1:1), 50 mg **5** (same solvent) and 30 mg **7** (same solvent).

Resorcinol derivatives **1a–3a**. Colourless gum, which could not be separated, IR $\nu_{max}^{CCl_4}$ cm^{-1}: 3620 (OH), 1605 (aromate); MS *m/z* (rel. int.): 348 (9), 334 (1.5), 320 (4.5), 124 $[C_7H_8O_2]^+$ (100) (McLafferty); ^{1}H NMR ($CDCl_3$): 6.18*t* (H-4), 6.25*d* (H-2, H-6), 2.49*t* (H-1'), 1.59*m*, 1.28*m* (CH_2), 0.89*t* (Me), [*J* (Hz) 2,4 = 2.5; 1,2 = 8]. To 20 mg **1a–3a** in 1 ml $CHCl_3$ 20 mg 4-dimethylaminopyridine and 0.1 ml Ac_2O were added. After standing overnight the usual work-up afforded 20 mg **1b–3b**, colourless gum, MS *m/z* (rel. int.): 432 (2), 418 (0.4), 404 (1), $[M]^+$, 390 (12), 376 (3), 362 (6), $[M - ketene]^+$, 348.303 (52), 334.287 (6), 320.272 (27) $[M - 2 \times ketene]^+$ ($C_{23}H_{40}O_2$, $C_{22}H_{38}O_2$ and $C_{21}H_{36}O_2$), 124 $[C_7H_8O_2]^+$ (100).

Conycephaloide (**4**). Colourless crystals, mp 208° (Et_2O); IR $\nu_{max}^{CHCl_3}$ cm^{-1}: 1780 (γ-lactone), 1680, 1590 (O–C=C–C=O), 880 (β-substituted furan); MS *m/z* (rel. int.): 340.131 $[M]^+$ (5) ($C_{20}H_{20}O_5$), 325 $[M - Me]^+$ (1), 311 $[M - CHO]^+$ (1.5), 94 $[C_5H_2O_2]^+$ (100).

$$[\alpha]_{24°}^{\lambda} = \frac{589 \quad 578 \quad 546 \quad 436\ nm}{-136 \quad -143 \quad -169 \quad -386} \quad (CHCl_3;\ c1.1).$$

7-Hydroxy-17-oxo-7, 8-dehydro-8, 17-dihydroconycephaloide (**5**). Colourless gum, IR $\nu_{max}^{CHCl_3}$ cm^{-1}: 3400–2700,

Table 2. ^{1}H NMR spectral data of compounds **4–6** and ^{13}C NMR spectrum of **4** (400 MHz, $CDCl_3$, TMS as int. standard)

	4	**5**	**6**	**4**(^{13}C NMR)	
H-1α	1.34*dddd*	1.30*dddd*	1.34*m*	C-1	20.3*t*
H-1β	1.90*dddd*	1.83*dddd*	1.84*br d*	C-2	26.9*t*
H-2α	2.53*dddd*	2.51*dddd*	2.54*dddd*	C-3	136.8*d*
H-2β	2.30*dddd*	2.23*dddd*	2.35*m*	C-4	135.5*s*
H-3	6.89*dd*	6.91*dd*	6.91*dd*	C-5	44.7*s*
H-6α	2.88*d*	2.75*d*	2.68*d*	C-6	49.6*t*
H-6β	2.28*dd*	2.37*br d*	2.37*br d*	C-7	196.1*s*
H-10	2.13*dd*	1.95*dd*	1.96*dd*	C-8	120.4*s*
H-11α	2.12*dd*	2.29*dd*	2.31*dd*	C-9	34.6*s*
H-11β	1.70*dd*	1.75*dd*	1.77*dd*	C-10	50.7*d*
H-12	5.22*dd*	5.63*dd*	5.55*dd*	C-11	41.8*t*
H-14	6.43*dd*	6.43*dd*	6.45*dd*	C-12	69.2*d*
H-15	7.51*dd*	7.44*dd*	7.43*dd*	C-13	124.7*br s*
H-16	7.1*dd*	7.51*dd*	7.48*br s*	C-14	108.4*dt*
H-17	7.42*s*	—	—	C-15	143.9*dt*
H-19	4.18*dd**	4.29*dd**	4.13*dd*	C-16	139.9*br d*
H-19′	4.15*d**	4.27*d**	4.45*d*	C-17	153.1*d*
H-20	1.10*s*	1.13*s*	1.16*s*	C-18	168.1*s*
OAc	—	—	2.22*s*	C-19	725t
OH	—	12.98*s*	—	C-20	23.3*q*

**Not first order.*

J (Hz): 1α,1β = 13; 1α,2α = 4; 1α,2β = 12; 1α,10 = 12; 1β,2α = 2.5; 1β,2β = 5; 1β,10 = 2; 2α,2β = 17; 2α,3 = 7; 2β,3 = 2; 6α,6β = 16; 6β,19 = 2; 11α,11β = 13; 11α,12 = 12; 11β,12 = 2.5; 14,15 = 15,16 = 1.5; 14,16 = 1.0; compounds **5** and **6**: 11β,12 = 4.5.

1660, 1615 (HO–C=C–C=O), 1790 (γ-lactone), 880 (furan); MS *m/z* (rel. int.): 356.126 $[M]^+$ (2) ($C_{20}H_{20}O_6$), 94 $[C_5H_2O_2]^+$ (100).

$$[\alpha]_{24°}^{\lambda} = \frac{589 \quad 578 \quad 546 \quad 436\,\text{nm}}{-60 \quad -64 \quad -75 \quad -145} \quad (CHCl_3;\ c0.56).$$

10 mg **5** was acetylated as above. Usual work-up afforded 8 mg **6**, colourless gum, MS *m/z* (rel. int.): 338 $[M-HOAc]^+$ (2), 94 (100); CI (*iso*-butane): 399 $[M+1]^+$ (100), 357 [399 − ketene]$^+$ (72).

Conypododiol (**7**). Colourless gum, IR $\nu_{max}^{CHCl_3}$ cm^{-1}: 3580, 3800 (OH), 880 (furan); MS *m/z* (rel. int.): 318 $[M]^+$ (0.1), 300 $[M-H_2O]^+$ (1), 285 $[300-Me]^+$ (3), 81 $[C_5H_5O]^+$ (72), 69 $[C_5H_9]^+$ (100). 10 mg **7** were acetylated as above; usual work-up gave 10 mg **8**, colourless gum, ^{1}H NMR see Table 1; MS *m/z* (rel. int.): 342 $[M-HOAc]^+$ (3), 282 $[342-HOAc]^+$ (3), 81 $[C_5H_5O]^+$ (67), 69 $[C_5H_9]^+$ (100). 10 mg **7** in 2 ml Et_2O were stirred for 2 hr with 100 mg MnO_2. TLC (Et_2O–petrol, 1:3) afforded 5 mg **9**, colourless gum, ^{1}H NMR see Table 1.

Acknowledgements—We thank Dr. B. de Winter and Miss M. Welman, Botanic Research Institute, Pretoria, for their help during plant collection and the identification of the species and the Deutsche Forschungsgemeinschaft for financial support.

REFERENCES

1. Bohlmann, F. and Jakupovic, J. (1979) *Phytochemistry* **18**, 1367.
2. Bohlmann, F., Burkhardt, T. and Zdero, C. (1973) *Naturally Occurring Acetylenes*, p. 463. Academic Press, London.
3. Dominguez, X. A., Quintero, G. and Butruille, D. (1972) *Phytochemistry* **11**, 1855.
4. Hammouda, F., Rizk, A., El Nozr, S. and El Kady, M. S. (1978) *Fitoterapia* 51.
5. Hammouda, F., Rizk, A. and El Kady, M. S. (1979) *Pharmazie* **34**, 112.
6. Sen, A., Mahato, S. and Dutta, N. (1975) *Indian J. Chem.* 504.
7. Bohlmann, F. and Grenz, M. (1972) *Chem. Ber.* **105**, 3123.
8. Tandon, S. and Rastogi, R. P. (1979) *Phytochemistry* **18**, 494.
9. Bohlmann, F., Kramp, W., Grenz, M., Robinson, H. and King, R. M. (1981) *Phytochemistry* **20**, 1907.
10. Ridley, D. D., Ritchie, E. and Taylor, W. C. (1968) *Aust. J. Chem.* **21**, 2979.
11. Bohlmann, F. and Mahanta, P. K. (1979) *Phytochemistry* **18**, 1067.
12. Hilliard, O. M. (1977) *Compositae in Natal*, p. 91. Pietermaritzburg University of Natal Press.
13. Skvarla, J. J., Turner, B. L., Patel, V. C. and Tomb, A. S. (1977) *The Biology and Chemistry of the Compositae* (Heywood, V. H., Harborne, J. B. and Turner, B. L., eds), p. 172. Academic Press, London.