Phytochemistry, 1978, Vol 17, pp 487–489 Pergamon Press Printed in England

DITERPENES WITH A NEW CARBON SKELETON FROM *PRINTZIA LAXA*

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(*Received* 4 *October* 1977)

Key Word Index—*Printzia laxa*; *P. pyrifolia*; Inuleae; Compositae; new diterpene skeleton; new clerodane derivatives.

Abstract—The aerial parts of the South African composite *Printzia laxa* contain two manoyl oxides and three clerodane derivatives together with two further acids, which belong to a new type of diterpene, biogenetically closely related to the clerodanes. The structures have been elucidated by spectroscopic methods. The constituents may indicate some relationship of *Printzia* to the tribe Astereae.

The South African genus *Printzia* has not been previously investigated chemically. The roots of *P. pyrifolia* contain matricaria ester **1** [1], while the aerial parts only yield methyl *p*-coumarate **2**. The roots of *P. laxa* afford traces of **3** [1] and the aerial parts several diterpenes, which could only be separated with difficulty. The acids therefore were esterified by diazomethane. The resulting ester mixture finally gave four compounds, the major constituent being the known (−)-hardwickiic acid (**5**) [2], isolated as its ester. The possible structures of two further esters, somewhat more polar than **5**, were elucidated by extensive ^{1}H-NMR-studies (see Table 1). All data are in good agreement with **7** and **9**; therefore the natural products are **6** and **8**. As shown in the scheme, these acids are most probably formed biogenetically from **4** by further oxidation and transformation via a cyclopropane to the isomeric acids **6** and **8**, which we have named printzianic and isoprintzianic acid.

Although the amount of material was very low, the NMR data clearly show that instead of having a 5-methyl group, the new acids have a methylene group, which must be located between two double bonds. As shown by double resonance experiments, these methylene protons couple with the protons at C-2 and C-3. The observed shifts after addition of Eu(fod)$_3$ and an ion in the MS of **9** probably formed by a retro-Diels–Alder (*m/e* 150), not present in the MS of **7**, support this assumption.

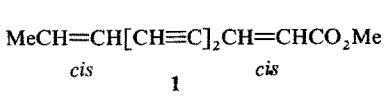
Table 1. ^{1}H-NMR data of **7**, **9** and **11** ($CDCl_3$, 270 MHz, δ-values, TMS as internal standard)

		7	Δ*		9		11
2-H	*m*	2.31	0.13	*m*	2.34	*m*	2.29
3-H	*ddd*	6.85	0.76	*ddd*	6.86	*dd*	6.34
6-H	*m*	2.31		*s(br)*	5.48		
8-H	*m*	1.68	0.05	*m*	1.75	*m*	1.75
12-H	*m*	2.31		*m*	2.34	*m*	2.29
14-H	*s(br)*	6.26	0	*s(br)*	6.27	*t(br)*	5.86
15-H	*t*	7.34	0	*t*	7.35	—	
16-H	*s(br)*	7.19	0	*s(br)*	7.21	*d(br)*	4.72
17-H	*d*	0.87	0.03	*d*	1.15	*d*	0.78
20-H	*s*	0.88	0.04	*s*	1.08	*s*	0.85
18-H	*d(br)*	3.20	0.46	*d(br)*	3.36	*s*	1.26
18′-H	*d(br)*	2.96	0.60	*d*	3.19		
OMe	*s*	3.73	0.70	*s*	3.73	*s*	3.72

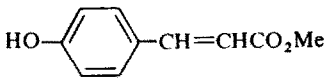
J(Hz): 2,3 = 6; 2′, 3 = 3.5; 3, 19 = 2; 18, 18′ = 16; 14, 15 = 14, 16 = 1.3; 8, 17 = 7; **11**: 2, 3 = 4; 14, 16 = 1.4.

* Δ-Values after addition of about 0.2 equivalents of Eu(fod)$_3$.

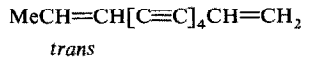
The structure of a more polar ester also follows from the spectroscopic data. The IR spectrum shows the presence of a γ-lactone; its structure clearly follows from the corresponding NMR signals [*t* 5.86 (1 H) and *d* 4.72 (2 H, *J* = 1.3)]. Therefore the natural product is best represented by the structure **10** (15, 16 H-16-oxohard-



1



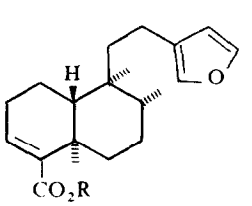
trans



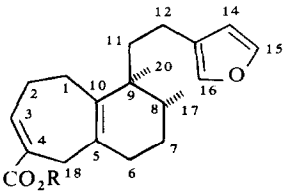
trans

3

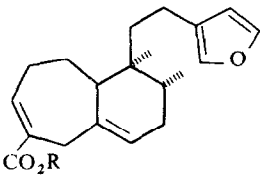
* Part 132 in the series 'Naturally Occurring Terpene Derivatives'; for part 131 see Bohlmann, F. and Fiedler, L. (1978) *Indian Chem. Soc.* in press.



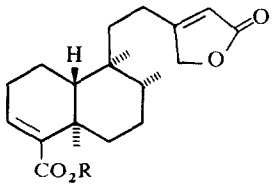
4: R = H 5: R = Me



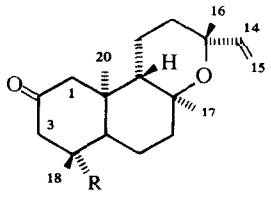
6: R = H 7: R = Me*



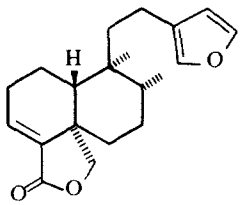
8: R = H 9: R = Me



10: R = H 11: R = Me



12: R = Me 13: R = CH_2OH



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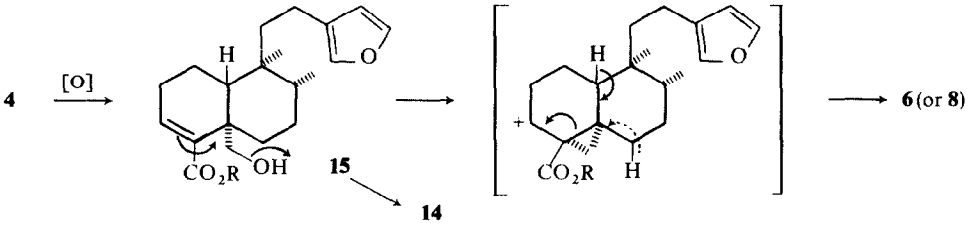


wickiic acid). Though the relative configuration at C-8 and C-9 as well as the absolute configurations of **6**, **8** and **10** have not been established, it is very likely that they are the same as in **4**. The mixture of the neutral compounds contain the antipodes of the known manoyl derivatives **12** [3] and **13** [4] together with a further lactone, identical with **14** previously isolated from a *Conyza* species [5a], but also from other families [5, 6]. **14** is the lactone of the predicted intermediate **15**, also isolated from *Conyza ivaefolia* [5a], in the biogenesis of **6** and **8**.

With regard to the structures of the isolated constituents, it is remarkable that most are typical compounds for several representatives of the tribe Astereae. This is especially so for **1** but also for the diterpenes, which are typical for *Solidago* species [6], and which also have the same configurations in the two series. However, this type of diterpene has also been recognized in members of other tribes. In the genus *Macowania*, probably very near to *Printzia*, similar diterpenes are also present [7] and **4** has been isolated from a *Brickellia* [8] as well as from a *Solidago* species [9]. Therefore the question whether these constituents may indicate a relationship to the tribe Astereae cannot be answered definitely. More results are certainly necessary.

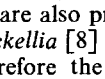
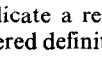
* For better comparison the same numbering as in normal systems has been used.

EXPERIMENTAL

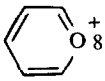
IR: Beckman IR 9, CCl_4; ^{1}H-NMR: Bruker WH 270, δ-values TMS as int. stand.; MS: Varian MAT 711, 70 eV; optical rotation: Perkin–Elmer polarimeter, $CHCl_3$. The air dried plant material was collected in Natal and extracted with Et_2O–petrol, 1:2. The extracts are first separated by column chromatography and further by TLC (Si gel, GF 254) using Et_2O–petrol. Known compounds are identified by comparison of the IR and NMR spectra.

Printzia pyrifolia (*voucher 77/279*). 210 g roots afforded 30 mg **1**, and 250 g aerial parts 30 mg **2**.

Printzia laxa *N.E. Br.* (*voucher 77/138*). 75 g roots yielded 1 mg **3**. The extract of 300 g aerial parts was first treated with MeOH to remove saturated long chain compounds and then separated by column chromatography. The fractions eluted with Et_2O–petrol (1:3 to 1:1) were reacted with CH_2N_2 in Et_2O (5 min) and then separated by TLC. Finally 80 mg **5**, 60 mg **12**, 10 mg **13**, 10 mg **11**, 6 mg **7** and 2 mg **9** (both Et_2O–petrol, 1:10) and 5 mg **14** (Et_2O–petrol, 1:1) were obtained.

Printzianic acid methylester (**7**) Colourless oil, IR: C=CCO_2R 1715, 1650, furan 1560, 878 cm^{-1}. MS: M^+ *m/e* 328.204 (18%) (calc. for $C_{21}H_{28}O_4$ 328.204); —$^{\cdot}CH_3$ 313 (2); —MeOH 296 (4); —$^{\cdot}CH_2CH_2$  233 (100); 233 —MeOH 201 (45); 201 —CO 173 (30);  81 (27).

$$[\alpha]^{\lambda}_{24^\circ} = \frac{\begin{matrix}589 & 578 & 546 & 436 & 365\,\text{nm}\end{matrix}}{\begin{matrix}-50 & -50\,5 & -59\,5 & -107 & -173^\circ\end{matrix}} (c = 0.2)$$

Isoprintzianic acid methyl ester (**9**). Colourless oil, IR: C=CCO$_2$R 1712, 1650; furan 1565, 873 cm^{-1}. MS: M$^+$ *m/e* 328.204 (14%) (calc. for $C_{21}H_{28}O_3$ 328.204); —MeOH 296 (4); —$^{\bullet}CH_2CH_2$  233 (100); 233 —MeOH 201 (34); 201 CO 173 (20);  81 (25).

15,16H-16-Oxohardwickiic acid methyl ester (**11**). Colourless oil, IR: lactone 1782; C=CCO$_2$R 1718, 1642 cm^{-1}. MS: M$^+$ *m/e* 346.214 (6%) (calc. for $C_{21}H_{30}O_4$ 346.214; —$^{\bullet}CH_3$ 331 (5); —MeOH 314 (100); 314 —$^{\bullet}CH_3$ 299 (32); 299 —CO 271 (25). $[\alpha]_D = -43°$ (c = 0.9).

2-Oxo-ent-manoyl oxide (**12**). Colourless oil, IR: C=O 1710 cm^{-1}; ^{1}H-NMR: Me *s* 0.74, 0.86, 1.05, 1.14, 1.22; CH=CH$_2$ *dd* 6.01, *d* 4.98, *d* 4.94 (J = 17, 10); 1-H and 3-H *dd* 2.37 (J = 13.5, 2) *d* 2.03 (J = 13.5), *d* 2.29, *dd* 2.18 (J = 13.5, 2)

$$[\alpha]^{\lambda}_{24°} = \frac{589 \quad 578 \quad 546\ \text{nm}}{+39 \quad +41 \quad +47.5°} \quad (c = 3.9)$$

2-Oxo-19-hydroxy-ent-manoyl oxide (**13**). Colourless oil, IR: OH 3640; >C=O 1710 cm^{-1}. MS: M$^+$ *m/e* 320 (4%); —$^{\bullet}CH_3$ 305 (39); 305 —H$_2$O 287 (38); C_3H_7 43 (100). ^{1}H-NMR: Me *s* 0.77, 1.15, 1.22, 1.26; CH=CH$_2$ *dd* 6.01, *d* 4.89, *d* 4.93 (J = 17, 10); 1-H and 3-H *dd* 2.57 (J = 14, 2), *d* 2.10 (J = 14); *dd* 2.41 (J = 14, 2), *d* 2.06 (J = 14); CH$_2$O *d* 3.53 and 3.44 (J = 12). 10 mg **13** were heated with Ac$_2$O for 30 min at 70°. After TLC (Et$_2$O–petrol, 1:3), 8 mg of the corresponding acetate were isolated, IR: OAc 1745, 1240; >C=O 1720 cm^{-1}. MS: M$^+$ *m/e*: —$^{\bullet}CH_3$ 347.222 (31%) (calc. for $C_{21}H_{31}O_4$ 347.222); 347 —H$_2$O 329 (19); 347 —AcOH 287 (9); 287 —H$_2$O 269 (20); MeCO$^+$ 43 (100). ^{1}H-NMR: Me *s* 0.78, 1.12, 1.15, 1.22; CH=CH$_2$ *dd* 6.01, *d* 4.99, *d* 4.95; 1-H and 3-H *dd* 2.56, *d* 2.14, *dd* 2.43, *d* 2.08; CH$_2$OAc *d* 3.96, *d* 3.88, *s* 2.04.

Acknowledgements—We thank Dr. O. Hilliard, Dept. of Botany, University of Natal, for her help in collecting and identification of the plant material, and the 'Deutsche Forchungsgemeinschaft' for supporting this investigation.

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