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A DITERPENE RELATED TO ERYTHROXYDIOL FROM *HELICHRYSUM REFLUXUM*

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Key Word Index—*Helichrysum refluxum*; Compositae; diterpene; erythroxane derivative.

Abstract—From *Helichrysum refluxum*, in addition to known compounds, a diterpene acid related to erythroxydiol Z was isolated. The structure was elucidated by NMR techniques.

In continuation of our investigation of *Helichrysum* species [1], we have now studied a species from Transvaal, *H. refluxum* N.E.Br. The aerial parts afforded in addition to widespread compounds several known diterpenes belonging to the kaurane, trachylobane and stachane series (see Experimental) as well as a new diterpene, the acid **1**, which was isolated as its methyl ester. The carbon skeleton was that of some rare diterpenes which have been isolated from an *Erythroxylon* species [2]. In the ^{1}H NMR spectrum of the ester in deuteriobenzene (Table 1) nearly all the signals could be assigned by spin decoupling thus clearly indicating that methyl groups were at C-5, C-9 and C-13. Irradiation of the low-field double-doublet at δ6.64, which obviously was that of H-3, allowed the assignment of H-2α and H-2β. As the latter were further coupled with the protons which showed signals at δ1.50 and 1.36, the H-1 signals were assigned as well. As these signals were coupled with a double-doublet at δ1.03, a proton was at C-10 which, however, had no further vicinal protons. Furthermore, the sequence H-6–H-7–H-8–H-14 as well as the signals of H-11 and H-12 could be fully assigned by spin decoupling. The configuration at C-13 was supported by the observed W-coupling of H-12α with H-17 which itself could be assigned by NOE difference spectroscopy. Irradiation of H-17 showed clear NOEs with H-15 and H-16 *trans*. Irradiation of H-19 and H-20 gave NOEs with H-7α. Accordingly, both methyls were axially orientated. The

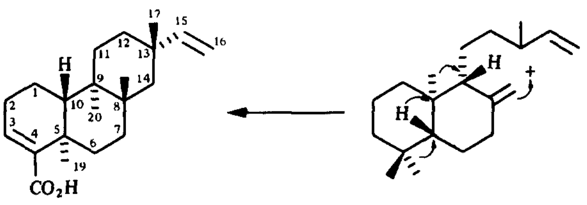
Table 1. ^{1}H NMR spectral data of 1-methyl ester (400 MHz, TMS as internal standard)

	C_6H_6	$CDCl_3^*$		C_6D_6	$CDCl_3$
H-1α	1.38 *dd*		H-12α	1.63 *br ddd*	
H-1β	1.50 *dd*	1.73 *dd*	H-12β	1.22 *ddd*	
H-2α	2.01 *dddd*	2.30 *dddd*	H-14α	1.36 *dd*	
H-2β	1.91 *dddd*	2.16 *dddd*	H-14β	0.99 *dd*	
H-3	6.64 *dd*	6.56 *dd*	H-15	6.38 *dd*	6.40 *dd*
H-6α	2.7 *ddd*	2.34 *ddd*	H-16*c*	4.98 *dd*	4.84 *dd*
H-6β	1.35 *ddd*		H-16*t*	5.05 *dd*	4.91 *dd*
H-7α	1.44 *dddd*	1.46 *m*	H-17	1.05 *br s*	1.00 *s*
H-7β	1.15 *dddd*		H-19	1.47 *s*	1.26 *s*
H-8	1.35 *dddd*		H-20	0.70 *s*	0.75 *s*
H-10	1.00 *dd*	1.13 *dd*	OMe	3.48 *s*	3.68 *s*
H-11α	1.44 *ddd*	1.44 *m*			
H-11β	0.89 *ddd*				

*Remaining signals are overlapped multiplets.

J (Hz): 1α, 1β = 13.5; 1α, 2α = 1.5; 1α, 2β = 10; 1α, 10 = 13; 1β, 2α = 5; 1β, 2β = 7; 2α, 2β = 19; 2α, 3 = 4.5; 2β, 3 = 3; 6α, 6β = 12.5; 6α, 7α = 6α, 7β = 3; 6β, 7α = 11; 6β,.7β ~ 3; 7α, 7β = 13; 7α, 8 = 10; 7β, 8 ~ 3; 8, 14α = 11; 8, 14β = 3; 11α, 11β = 13; 11α, 12α = 4; 11α, 12β ~ 3; 11β, 12α = 13; 11β, 12β = 4; 12α, 12β = 13; 12α, 17 ~ 0.5; 15, 16*c* = 11; 15, 16*t* = 17.5; 16*c*, 16*t* = 1.5.

^{13}C NMR spectrum was in agreement with the proposed structure and configuration (see Experimental). The observed optical rotation may be an indication that **1** has the same absolute configuration as erythroxydiol [2]. We propose for this carbon skeleton the name erythroxane; **1** therefore is erythroxa-3,15-dien-18-oic acid. Most likely this system is formed as indicated in Scheme 1. *Helichrysum* species which contain diterpenes of different types have been observed previously [1], though normally other constituents were isolated.



1

Scheme 1.

EXPERIMENTAL

The air-dried plant material (voucher 81/123, collected in February 1981 in Transvaal) was worked-up in the usual fashion [3]. The crude extract of the aerial parts (175 g) was first separated by CC affording the following fractions: 1 (petrol), 2 (Et_2O–petrol, 1:9), 3 (Et_2O–petrol, 1:3) and 4 (Et_2O–petrol, 1:1 and Et_2O). TLC of fraction 1 (petrol) gave 7 mg bicyclogermacrene, 4 mg cadinene, 4 mg aromadendrene, 3 mg α-cedrene and 7 mg squalene (identified by GC/MS and by ^{1}H NMR comparison with authentic material). TLC of fractions 2 and 3 (Et_2O–petrol, 1:3) gave 5 mg trachylobanic acid, 10 mg *ent*-kaurenic acid, 100 mg beyeren-19-oic-acid [4], 70 mg lupeol and its Δ^{12}-isomer (*ca* 1:2) and 40 mg crude **1** which was purified as its methyl ester by TLC (Et_2O–petrol, 1:9) (R_f 0.6). TLC of fraction 4 (Et_2O–petrol, 1:1) gave 75 mg oleanolic acid, 20 mg 2,3-dihydroaromaticin [5] and 15 mg carabron [6]. Known compounds were identified by comparing the 400 MHz ^{1}H NMR spectra with those of authentic material and by co-TLC in different solvent systems.

Methyl erythroxa-3,15-*dien*-18-*oate*. Colourless crystals, mp 103°; IR $\nu_{max}^{CCl_4}$ cm^{-1}: 1720 (CO_2R), 915 ($CH{=}CH_2$); MS *m/z* (rel. int.): 316.240 $[M]^+$ (91) (calc. for $C_{21}H_{32}O_2$: 316.230), 301 $[M-Me]^+$ (85), 285 $[M-OMe]^+$ (64), 269 $[301-MeOH]^+$ (11), 257 $[285-CO]^+$ (33), 242 $[269-CH{=}CH_2]^+$ (56), 107 $[C_8H_{11}]^+$ (100); ^{13}C NMR ($CDCl_3$, C-1–C-20): 16.9 *t*, 27.3 *t*, 136.7 *d*, 142.5 *s*, 38.0 *s*, 32.0 *t*, 25.8 *t*, 42.4 *d*, 36.4 *s*, 36.7 *t*, 35.1 *t*, 36.8 *s*, 39.0 *t*, 151.3 *d*, 108.6 *t*, 23.2 *q*, 167.9 *s*, 21.5 *q*, 12.4 *q*, 54.1 *q* (OMe);

$$[\alpha]^{\lambda}_{24^\circ} = \frac{589 \quad 578 \quad 546 \quad 436\,\text{nm}}{-84 \quad -104 \quad -125 \quad -225}\ (\text{CHCl}_3;\ c\ 0.5).$$

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