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AN ANOMALOUS SESQUITERPENE FROM *HELICHRYSUM DAVYI*

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Key Word Index—*Helichrysum davyi*; Compositae; sesquiterpene; anomalous carbon skeleton; synthesis.

Abstract—From the roots of *Helichrysum davyi*, in addition to known compounds, a sesquiterpene hydrocarbon with a new carbon skeleton was isolated. Its structure was elucidated by spectroscopic methods and by synthesis.

INTRODUCTION

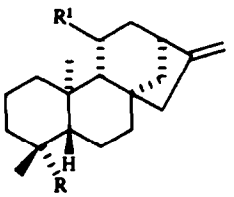
The roots of the South African *Helichrysum davyi* S. Moore afforded α-humulene, caryophyllene, the *ent*-kaurene derivatives **1** [1], **2** [2], **3** [2], **4** [3], **5** [4], **6** [5] and its corresponding diol **7** which was identical with the diol obtained by saponification of **6**. The structures followed from the ^{1}H NMR spectra which were identical with those of authentic material. In addition small amounts of the hydrocarbon **8** was isolated.

The structure of **8** followed from its highfield ^{1}H NMR spectrum (see Experimental). Spin decoupling allowed the assignment of all signals and led to sequences which clearly showed that the isopropenyl group was at C-8, thus excluding the presence of an eremophilane derivative. The stereochemistry was established by NOE difference spectroscopy. Thus clear effects were observed between H-15, H-3β (4%) and H-6 (5%) as well as between H-14, H-2β (4%), H-4 (5%), H-7β (5%) and H-9β (4%). The couplings of H-8 further indicated an axial orientation of the isopropenyl group. The ^{13}C NMR signals also agreed with the proposed structure. As no sesquiterpene with the same carbon skeleton had been reported previously the synthesis of **8** was undertaken. A suitable starting material was dihydrocarvone. A modified Robinson anellation as reported for dimethyl octalin-2-one [6] was expected to give the desired stereochemistry with *trans*-orientated methyl groups. However, the stereochemistry at C-7 was not easily predictable. Reaction of (+)-dihydrocarvone with 3*E*-penten-2-one and sodium hydride in DMSO afforded the crystalline ketone **13** in 25% yield (mp 64–65°, ^{1}H NMR ($CDCl_3$): δ5.80 *d* (H-1), 2.19 and 2.76 *dd* (H-3), 1.90 *ddq* (H-4), 1.8–1.95 *m* (H-5, H-6), 2.49 *m* (H-7), 2.52 *dd* and 2.66 *dddd* (H-8), 0.98 *d* (H-9), 1.35 *s* (H-10), 1.72 *br s* (H-11), 4.73 and 4.87 *br s* (H-12) [*J* (Hz): 1,8 = 2; 3,3′ = 16.5; 3,4 = 3.5; 3′,4 = 5; 4,9 = 7.5; 6,8′ = 2; 7,8 = 2; 7,8′ = 6; 8,8′ = 16]. The small couplings of H-7 indicated the desired configuration at this centre. The ketone **13** was transformed by a modified Wolff–Kishner reduction via the semicarbazone [7] to the hydrocarbon **8**, colourless oil, $bp_{0.05}$ 45°, whose spectral data and optical rotation were identical with those of the natural product, whose absolute configuration was thus established.

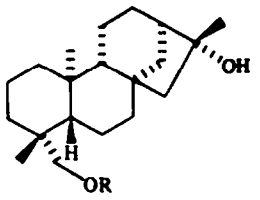
The biosynthesis of **8** probably proceeds via the intermediate **9** which could rearrange to the skeleton **10** which in turn would give **8** by migration of the other carbon bond. This would be in agreement with the observed stereochemistry.

EXPERIMENTAL

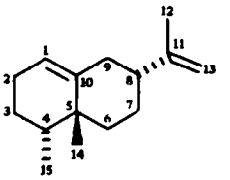
The roots (100 g, voucher 81/255, collected in Transvaal) were extracted with Et_2O–petrol (1:2) and the extract obtained was separated as reported previously [8] by CC and PTLC (Silica gel, PF 254) affording 20 mg **1**, 30 mg **2**, 50 mg **3**, 300 mg **4**, 35 mg **5**, 15 mg **6**, 30 mg **7** and 5 mg **8**, colourless oil; MS *m/z* (rel. int.): 204.188 $[M]^+$ (37) $[C_{15}H_{24}]^+$ 189 $[M-Me]^+$ (71), 162 $[M-C_3H_6$, RDA$]^+$ (100), 161 (90), 147 (51), 133 (56), 119 (97), 107 (76), 105 (79), 93 (68), 91 (76); ^{1}H NMR ($CDCl_3$): δ5.31 (*ddd*, H-1), 2.01 (*m*, H-2α), 1.88 (*m*, H-2β), 1.32 (*dddd*, H-3α), 1.72 (*m*, H-3β), 1.50 (*ddq*, H-4), 1.60 (*ddd*, H-6α), 0.98 (*dd*, H-6β), 1.70 (*m*, H-7), 1.85 (*m*, H-7β), 2.31 (*m*, H-8), 2.23 (*ddd*, H-9), 2.54 (*dddd*, H-9β), 1.70 (*br s*, H-12), 4.87 and 4.82 (*br s*, H-13), 1.15 (*s*, H-14), 0.86 (*d*, H-15) [*J* (Hz): 1,2α = 1,2β = 1,9β = 2,9β ~ 2; 2α,3α = 2β,3α = 3α,4 = 5; 3α,3β = 13; 3β,4 = 3; 4,15 = 7; 6α,6β = 13; 6α,7α = 4; 6α,7β = 12; 7α,9α = 8,9α = 2; 8,9β = 3; 9α,9β = 14]; ^{13}C NMR ($CDCl_3$, C-1–C-15): 120.2 *d*, 29.4 *t*, 35.5 *t*, 40.3 *d*, 37.6 *s*, 26.5 *t*, 22.9 *t*, 38.6 *d*, 24.0 *t*, 140.2 *s*, 147.8 *s*, 25.4 *q*, 108.0 *t*, 15.0 *q*, 22.7 *q*; $[\alpha]_D^{24°}$ −20° ($CHCl_3$; *c* 0.05).



	1	2	3	4	5
R	Me	CH_2OH	CHO	CO_2H	CO_2H
R^1	H	H	H	H	OAc



6 R = Ac
7 R = H



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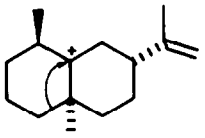

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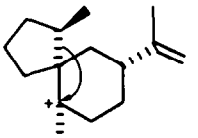

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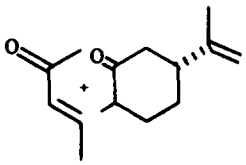
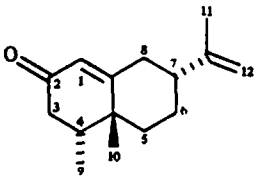


11 **12**



13

8

* NaH, DMSO, 3 hr, 20°

† Semicarbazide acetate - EtOH (12 hr reflux) then semicarbazone in toluene (25 hr reflux) with potassium tert - butoxide.

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