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HIGHLY UNSATURATED AMIDES FROM *SALMEA SCANDENS*

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Key Word Index—*Salmea scandens*; Compositae; unsaturated amides; phenylethylamine derivatives.

Abstract—The aerial parts of *Salmea scandens* gave, in addition to three known amides, three new ones. The chemotaxonomy of this genus is discussed briefly.

The small tropical American genus *Salmea* has not been studied chemically. We have therefore investigated *Salmea scandens* (L.) DC. The aerial parts contain germacrene D, squalene, nerolidol, spathulenol and the isobutylamide **1**, the phenylethylamides **2** and **3**, which have been isolated from a *Spilanthes* species [1], as well as three further ones, the epoxide **4**, the enzyme **5**, and the aldehyde **6**. The structure of **5**, molecular formula $C_{18}H_{21}NO$, followed from the ^{1}H NMR spectrum (see Experimental), which clearly showed the presence of a phenylethylamide residue. Spin decoupling allowed the assignment of all signals. The couplings of H-2 and H-3 indicate a *Z*-configuration of the conjugated double bond. The presence of two methylene groups followed by a ynene chromophore also followed from the ^{1}H NMR signals as H-5 was a narrowly split triplet which collapsed to a clear triplet by irradiation of the broad double-quartet at δ5.42 (H-8). As this signal showed an 11 Hz coupling this double bond also had a *Z*-configuration.

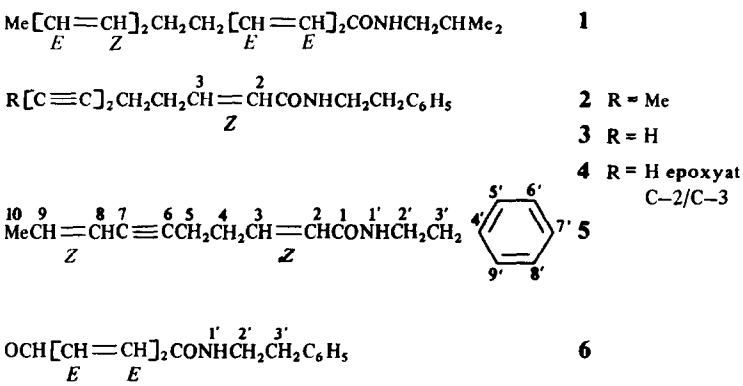
The ^{1}H NMR spectrum of **4** (see Experimental), which gave no molecular ion by the EI technique, but a clear $[M+1]^+$ ion by chemical ionization, showed that an epoxide was present. Thus H-2 was a doublet at δ3.49 (J = 5 Hz) which was coupled with a double-triplet at δ3.23. The presence of a diyne end group followed from the mass spectrum and the typical long range coupling of the acetylenic proton.

The ^{1}H NMR spectrum of **6** (see Experimental) indicated by the presence of a low-field doublet at δ9.64 that an aldehyde was present. Again only by chemical ionization was a $[M+1]^+$ peak obtained. All ^{1}H NMR signals were assigned by spin decoupling. Most likely **6** was formed by oxidative degradation of an amide similar to **1** with a phenylethylamide residue.

The chemistry of *Salmea* seems to be very similar to *Spilanthes* and *Acmella*, where highly unsaturated amides are common [1–5]. These compounds are also present in species of *Echinacea* [6] and *Heliopsis* [7]. Bolick [8] has discussed the cladistic relationships of *Salmea* and relates the genus directly to *Spilanthes* and *Acmella*, as do the chemical data. Indeed, several species of *Salmea* previously placed in *Spilanthes* by earlier workers have recently been transferred back to *Salmea* [9]. Robinson [10] comments upon the close relationship of *Salmea* and *Acmella* to *Verbesina* but Bolick reckons the relationship of this complex to be with *Otopappus*, a genus whose chemistry is inadequately known at present.

EXPERIMENTAL

The air-dried aerial parts (460 g, collected in Mexico, voucher Turner and Tapia 15518, TEX) were extracted with MeOH–Et_2O–petrol, 1:1:1, at room temp. and worked up in the usual fashion [11]. CC fractions were as follows: 1 (petrol and



Et_2O–petrol, 1:9), 2 (Et_2O–petrol, 1:1) and 3 (Et_2O and Et_2O–MeOH, 9:1). TLC (petrol) of fraction 1 gave 40 mg germacrene D and 860 mg squalene. TLC of fraction 2 (Et_2O–petrol, 1:1) gave 6 mg nerolidol and 21 mg spathulenol. TLC of 150 mg of fraction 3 (total 21 g) (Et_2O–petrol, 4:1) gave two crude bands (3/1 and 3/2) which were separated further by HPLC (RP 8, MeOH–H_2O, 3:2, *ca* 100 bar, flow rate 3 ml/min), 3/1 affording 3.8 mg **3** (R_t 7.3 min), a mixture (3/1/2) (R_t 9.4 min), 5 mg **5** (R_t 12.1 min) and 6 mg **1** (R_t 20.1 min). TLC (Et_2O–petrol, 4:1, 3 developments) and HPLC (see above) of 3/1/2 gave 2 mg **2** (R_t 10.1 min) and 0.6 mg **6** (R_t 0.5 min). TLC (CH_2Cl_2–C_6H_6–Et_2O, 1:1:1) of 3/2 gave 8 mg **4** (R_f 0.6). Known compounds were identified by comparing the 400 MHz ^1H NMR spectra with those of authentic material.

Nona-6,8-diyn-2,3-epoxy-1-oic acid phenylethylamide (**4**). Colourless oil; IR $\nu_{max}^{CCl_4}$ cm^{-1}: 3425, 1690, 1520 (CONHR), 3320, 2200 (HC≡C); CIMS (isobutane) *m/z* (rel. int.): 268 $[M+1]^+$ (47), 177 $[268-C_7H_7]^+$ (100); ^1H NMR ($CDCl_3$, 400 MHz, TMS as internal standard): δ3.49 (*d*, H-2), 3.23 (*dt*, H-3), 1.41 (*ddt*, H-4), 1.63 (*ddt*, H-4'), 2.35 (*dt*, H-5), 2.05 (*t*, H-9), 3.67 (*dq*, H-2_1'), 3.49 (*dq*, H-2_2'), 2.87 (*dt*, H-3_1'), 2.79 (*dt*, H-3_2'), 7.18 (*br d*, H-5', H-9'), 7.22 (*t*, H-7'), 7.31 (*t*, H-6', H-8'); [*J* (Hz): 2, 3 = 5, 3, 4 = 8; 4, 4' = 14; 4, 5 = 7; 5, 9 = 1; NH, 2' = 2', 3' = 7; 2_1', 2_2' = 3_1', 3_2' = 14, 5', 6' = 6', 7' = 8].

Deca-2Z,8Z-dien-6-yn-1-oic acid phenylethylamide (**5**). Colourless oil, IR $\nu_{max}^{CCl_4}$ cm^{-1}: 3470, 1675, 1500 (CONHR), 3025, 1600 (CH=CH); MS *m/z* (rel. int.): 267.162 $[M]^+$ (27) (calc. for $C_{18}H_{21}NO$: 267.162), 252 $[M-Me]^+$ (7), 176 $[M-C_7H_7]^+$ (8), 147 $[M-C_9H_{12}]^+$ (29), 123 $[176-C_4H_5]^+$ (100), 120 $[C_9H_{12}]^+$ (63), 119 $[C_9H_{11}]^+$ (60), 105 $[C_8H_9]^+$ (95), 104 $[C_8H_8]^+$ (60), 91 $[C_7H_7]^+$ (61), 79 $[C_6H_7]^+$ (54), 77 $[C_6H_5]^+$ (55); ^1H NMR ($CDCl_3$, 400 MHz, TMS as internal standard): δ5.71 (*dt*, H-2), 6.07 (*dt*, H-3), 2.82 (*ddt*, H-4), 2.42 (*dt*, H-5), 5.42 (*dq*, H-8), 5.90 (*dq*, H-9), 1.82 (*dd*, H-10), 3.36 (*t*, H-2'), 2.85 (*t*, H-3'), 7.20 (*br d*, H-5', H-9'), 7.24 (*t*, H-7'), 7.31 (*t*, H-6', H-8'), 5.62 (*br s*, NH); [*J* (Hz): 2, 3 = 8, 9 = 11; 2, 4 = 5, 8 = 2; 3, 4 = 4, 5 = 9, 10 = NH, 2' = 2', 3' = 7; 5', 6' = 6', 7' = 8].

6-Oxo-hexa-2E,4E-dien-1-oic acid-N-phenylethylamide (**6**). Colourless oil; IR $\nu_{max}^{CCl_4}$ cm^{-1}: 3440, 1680, 1500 (CONHR), 2730, 1690 (CHO); CIMS *m/z* (isobutane) *m/z* (rel. int.): 230 $[M+1]^+$ (100); ^1H NMR ($CDCl_3$, 400 MHz, TMS as internal standard): δ6.19 (*d*, H-2), 7.37 (*dd*, H-3), 7.11 (*dd*, H-4), 6.40 (*dd*, H-5), 9.64 (*d*, H-6), 3.65 (*dt*, H-2'), 2.88 (*t*, H-3'), 7.20 (*br d*, H-5', H-9'), 7.25 (*t*, H-7'), 7.33 (*t*, H-6', H-8'); [*J* (Hz): 2, 3 = 4, 5 = 15; 3, 4 = 11; 5, 6 = 7.5; NH, 2' = 2', 3' = 7; 5', 6' = 6', 7' = 8].

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