Pergamon

0031-9422(95)00650-8

Phytochemistry, Vol. 41, No. 3, pp. 851–853, 1996

0031-9422/96 $15.00 + 0.00

CONSTITUENTS OF TWO *ACALYPHA* SPECIES

K. SIEMS, J. JAKUPOVIC,*† V. CASTRO‡ and L. POVEDA‡

AnalytiCon GmbH, D–13355 Berlin, Germany; *Institute for Organic Chemistry, Technical University of Berlin, D–10623 Berlin, Germany; ‡Escuela de Quimica, Universidad de Costa Rica, San Jose, Costa Rica

(*Received* 4 *July* 1995)

Key Word Index—*Acalypha macrostachya*; *A. diversifolia*; Euphorbiaceae; diterpene; friedolabdane.

Abstract—The stem extract of *Acalypha macrostachya* yielded, in addition to known compounds, two new friedolabdanes and a new curcumene derivative. *A. diversifolia* gave a known amide. The structures were elucidated by high-field NMR spectroscopy.

INTRODUCTION

The spurge family Euphorbiaceae is known as a source of biologically active compounds [1]. Phorbolesters have been extensively investigated for their cocarcinogenic properties [2]. With about 450 species, *Acalypha* is the fourth largest genus of Euphorbiaceae. The species are widespread throughout the tropics except in Hawaii and a few Pacific archipelagos [3]. Extracts of some *Acalypha* sp. are used in Central America as folk medicine [4]. To date only a few representatives have been investigated chemically [5]. As a part of our study on constituents from the Euphorbiaceae, we examined two Acalypha species, *A. macrostachya* and *A. diversifolia*, both collected in Costa Rica.

RESULTS AND DISCUSSION

The stem extract of *A. macrostachy* a Jacq. yielded the diterpenes **1** and **2**, the sesquiterpene **3**, *N-trans*-feruloyltyramin, previously isolated from different sources [6] and β-stigmasterone. The structures of the isomeric diterpenes were deduced from ^{1}H and ^{13}C NMR spectra (Tables 1 and 2). The presence of a β-substituted furan followed from the typical down field signals in the NMR spectra. A pair of doublets at δ3.42 and 3.82 in the ^{1}H NMR spectrum of **1** indicated a primary hydroxyl group, which was confirmed by a triplet at δ69.4 in the ^{13}C NMR spectrum. Two tertiary and one secondary methyl group were consistent with several skeleta, particularly with that of friedolabdane. Spin decoupling experiments established the sequence H-6, H-10, H-1 to H-3, because H-6 and H-10 were allylically coupled. In accordance with the structure, the keto group has to be placed at C-7, as H-8 is shifted downfield and couples only with the secondary methyl group. The stereochemistry was fully established by a series of NOE experiments. The most important enhancements were observed between H-20, H-17 (6%), H-12 (5%) and H-12′ (5%), between H-19, H-18 (3%), H-18′ (3%) and H-10 (7%), between H-10, H-8 (5%) and H-11 (5%) as also between H-18 and H-6 (7%).

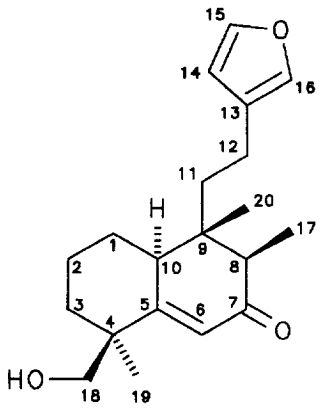
In the NMR spectra of **2** the signals for the hydroxymethyl group were missing. Instead, those for an additional methyl group and a secondary alcohol were recognized. The placement of the latter at C-3 followed

Table 1. ^{1}H NMR data of compounds **1** and **2** ($CDCl_3$, 400 MHz, internal standard: residual $CHCl_3$, signal = 7.26 ppm)

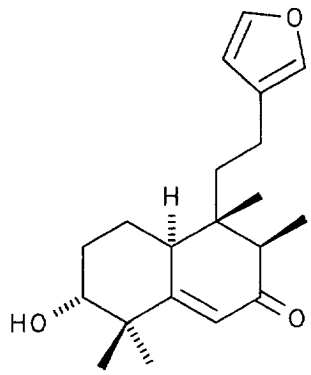
H	1	J	2	J
1α	1.90 *br d*	13	*	
1β	1.26 *ddd*	13, 13, 13, 3	*	
2α	1.65 *m*		*	
2β	1.72–1.82 *m*		*	
3α	1.49 *m*		3.42 *dd*	12, 4
3β	1.72–1.82 *m*		—	
6	5.97 *d*	2	6.05 *d*	2
8	2.50 *q*	7	2.47 *q*	7
10	2.66 *ddd*	13, 5, 2	2.64 *ddd*	13, 5, 2
11	1.74 *m*		1.73 *ddd*	14, 14, 4
11′	1.56 *m*		1.57 *ddd*	14, 14, 4
12	2.35 *ddd*	14, 14, 4	2.35 *ddd*	14, 14, 4
12′	2.44 *ddd*	14, 14, 4	2.46 *ddd*	14, 14, 4
14	6.28 *br s*		6.28 *br s*	
15	7.23 *br s*		7.23 *br s*	
16	7.36 *br s*		7.37 *br s*	
17	1.05 *d*	7	1.06 *d*	7
18	3.42 *d*	11.5	1.28 *s*	
18	3.82 *d*	11.5	—	
19	1.08 *s*		1.08 *s*	
20	0.74 *s*		0.74 *s*	

*Overlapping multiplets.

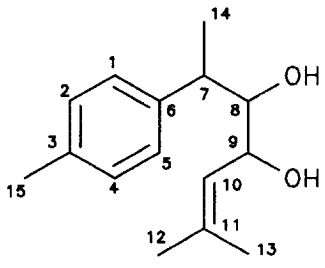
†Author to whom correspondence should be addressed.



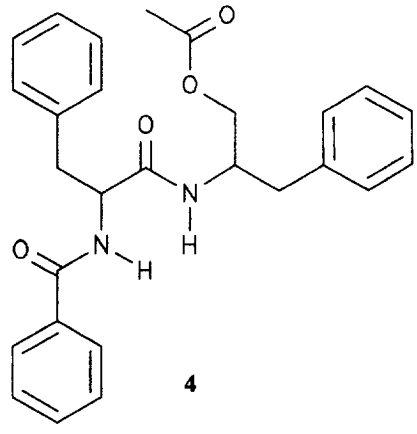
1



2



3



4

from spin decoupling experiments and the stereochemistry from the observed couplings in the ^{1}H NMR spectrum (J = 12 and 4 Hz). The absolute configuration of **1** was deduced from the negative Cotton-effect observed at 320 nm according to the helicity rule for α,β-unsaturated ketones [7]. An analogous effect was described with a friedolabdane isolated from *Haplopappus pulchellus* [8].

Small amounts of curcumene diol **3** were also obtained. The structure was easily deduced from the ^{1}H NMR spectrum (see Experimental). The stereochemistry at the chiral centres could not be established.

The leaf extract of the same sample contained no compounds of interest.

Only the amide **4** was obtained from *A. diversifolia*. Interestingly, this compound was previously isolated from *Artemisia anomala*, family Compositae [9].

EXPERIMENTAL

The air-dried material (collected in Sarapiqui, Costa Rica, December 1989; voucher specimen deposited at National Herbarium of Costa Rica) was extracted at room temp with petrol–Et_2O–MeOH (1 : 1 : 1). The defatted extract was separated by CC (silica gel) using petrol, methyl-t-butyl ether (MTB) and MeOH with increasing polarity. The fractions were checked by ^{1}H NMR prior to further purification by TLC or HPLC. The stem extract of *A. macrostachya* (1580 g, Herbar No. 4665) yielded 30 mg β-stigmasterone, 60 mg **1** (HPLC: MeOH–H_2O 4 : 1, RP 8, 250 × 8 mm, R_t = 5 min), 5 mg **2** (TLC: petrol–MTB 3 : 2, R_f 0.4), 5 mg **3** (TLC: petrol–MTB 3 : 2, R_f 0.5) and 50 mg *N-trans*-feruloyltyramine. The aerial parts of *A. diversifolia* (870 g, Herbar No. 4652) contained 5 mg **4**. Known compounds were identified by comparison of ^{1}H NMR spectra with those of authentic samples.

18-*Hydroxy*-7-*oxo*-15,16-*epoxyfriedolabda*-5,13(16),14-*trien* (**1**). IR $\nu_{max}^{CCl_4}$ cm^{-1}: 3500, 1680, 880; MS *m/z* (rel. int.): 316.204 $[M]^+$ (40) (calc. for $C_{20}H_{28}O_3$), 221 $[M - \text{side chain}]^+$ (59), 203 $[221 - H_2O]^+$ (100), 191 (32), 189 (36), 161 (58), 135 (66), 95 (57), 81 (71); CD $\Delta\varepsilon_{320}$ − 1.8 (MeOH; *c* 0.15).

3α-*Hydroxy*-7-*oxo*-15,16-*epoxyfriedolabda*-5,13(16),14-*trien* (**2**). IR $\nu_{max}^{CCl_4}$ cm^{-1}. 3480, 1680, 880; MS *m/z* (rel. int.):

Table 2. ^{13}C NMR data of compounds **1** and **2** ($CDCl_3$, 100 MHz, internal standard: solvent peak = 77.0 ppm)

C	1	2
1	33.9 *t*	37.0 *t*
2	20.6 *t*	29.7 *t*
3	36.7 *t*	75.7 *t*
4	42.4 *s*	42.9 *s*
5	165.7 *s*	167.3 *s*
6	121.9 *d*	122.4 *d*
7	202.4 *s*	202.7 *s*
8	48.0 *d*	47.7 *d*
9	41.4 *s*	40.6 *s*
10	41.9 *d*	40.7 *d*
11	18.8 *t*	18.9 *t*
12	25.9 *t*	23.9 *t*
13	124.7 *s*	124.6 *s*
14	110.8 *d*	110.7 *d*
15	142.9 *d*	142.9 *d*
16	138.5 *d*	138.4 *d*
17	7.7 *q*	8.1 *q*
18	69.4 *t*	23.9 *q*
19	25.2 *q*	21.8 *q*
20	16.5 *q*	16.8 *q*

Assigned with aid of two-dimensional hetero correlated experiment.

316.204 $[M]^+$ (40) (calc. for $C_{20}H_{28}O_3$), 221 [M − side chain]$^+$ (59), 203 $[221 - H_2O]^+$ (100), 119 (50).

7,8-*Dihydroxy-α-curcumene* (**3**). MS *m/z* (rel. int.): 234 $[M]^+$ (5.5), 216 $[M - H_2O]^+$ (2), 119 (100); ^1H NMR ($CDCl_3$ solvent peak 7.26 ppm): 7.12 (4H, *m*, H-1, H-2, H-4 and H-5), 5.29 (1H, *tqq*, $J = 9$, 1.5, 1.5, H-10), 4.10 (1H, *dd*, $J = 6$, 9, H-9); 3.54 (1H, *dd*, $J = 6$, 6, H-8), 2.91 (1H, *dq*, $J = 6$, 7, H-7), 2.32 (3H, *s*, H-15), 1.77 (3H, *d*, $J = 1.5$, H-12),1.63 (3H, *d*, $J = 1.5$, H-13), 1.35 (3H, *d*, $J = 7$, H-14).

REFERENCES

1. Evans, F. J. and Taylor, S. E. (1983) *Fortschritte der Chemie org. Naturstoffe* **44**, 1.
2. Hecker, E. and Schmidt, R. (1974) *Fortschritte der Chemic org. Naturstoffe* **31**, 377.
3. Webster, G. L. (1994) *Ann. Missouri Bot. Garden* **81**, 33.
4. Morton, J. J. (1981) *Medicinal plants of Middle America* Charles C. Thomas Publisher, Springfield.
5. Talapatra, B., Gosnani, S. and Talapatra, S. K. (1981) *Ind. J. Chem.* (B) **20**, 974.
6. Tanaka, B., Nakamura, T., Ichino, K. and Ito, K. (1989) *Phytochemistry* **28**, 2516.
7. Snatzke, G. (1965) *Tetrahedron* **21**, 421.
8. Zdero, C., Bohlmann, F. and Niemeyer, H. M. (1991) *Phytochemistry* **30**, 3669.
9. Jakupovic, J., Chen, Z.-L. and Bohlmann, F. (1987) *Phytochemistry* **26**, 2777.