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# CADINENE DERIVATIVES FROM *SMALLANTHUS UVEDALIA*

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**Key Word Index**—*Smallanthus uvedalia*; Compositae; cadinene derivatives, sesquiterpene lactones, sesquiterpenes.

**Abstract**—The aerial parts of *Smallanthus uvedalia* afforded in addition to known compounds five new cadinene derivatives. The structures were elucidated by high field $^1$H NMR spectroscopy.

*Smallanthus uvedalia* (Li) Mackenzie (= *Polymnia uvedalia* (L.) L. has been investigated previously. The sample collected in West Virginia gave several melampolides [1–4]. We have now studied the same species collected in Mexico near Monterrey. Careful separation of the less polar fractions gave α- and β-santalene, α-bergamotene, α-bisabolene, humulene, β-farnesene, germacrene D, caryophyllene and squalene.

The next fraction afforded **1**, which has been prepared already from the carbinol [5], **3** [6] and five new cadinene derivatives, 2-oxo-verboccidentafuran (**4**) 2-oxo-9,12-dehydroverboccidentene **2** and the oxidation products **5**–**7**. Furthermore *p*-hydroxybenzaldehyde, *p*-hydroxybenzylalcohol and bornyl ferulate were present.

The structure of **2** clearly followed from the $^1$H NMR spectrum (Table 1) which was close to that of **1**. However, due to the changed position of the keto group several signals were shifted drastically. The down field shift of H-4 showed that the keto group now was at C-2.

The spectrum of **4** (Table 1) was close to that of verboccidentafuran [5]. The presence of a 2-keto group again clearly followed from the downfield shift of H-4 (δ6.57 *ddq*). The H-1 signals were also shifted downfield (δ2.58 and 2.77 *dd*).

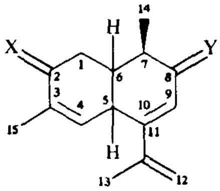
The $^1$H NMR spectrum of **5** (Table 1) together with the molecular formula ($C_{15}H_{18}O_2$) indicated that a lactone derived from verboccidentafuran was present. Spin decoupling allowed the assignment of all signals, though some were overlapping multiplets. We have named compound **5**, 8,9-dehydroverboccidenta lactone.

The $^1$H NMR spectrum of **6** and **7** (Table 1) indicated that again lactones were present. In part the spectra were close to that of **4**. However, an additional oxygen function was at C-9. Accordingly, the H-8 signals were shifted upfield. As already indicated by the molecular formula, **7** was the methyl ether of **6**. Accordingly, in the spectrum of **7** a methoxy singlet at δ3.11 was visible. The configuration at C-9 followed from the downfield shift of H-5.

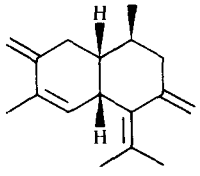
## EXPERIMENTAL

The aerial parts (860 g, collected at Chipinque, N. L., August, 1986, voucher 8137 in ITESM herbarium) were extracted with MeOH–isopropyl ether–petrol, (1:1:1). The resulting extract (16.0 g) was separated first by CC ($SiO_2$) into four fractions (1: petrol and $Et_2O$–petrol, (1:9) 2: $Et_2O$–petrol, (1:1) 3: $Et_2O$ and 4: $Et_2O$–MeOH, (9:1). TLC of fraction 1 ($AgNO_3$ coated $SiO_2$) gave 5 mg α- and 4 mg β-santalene, 7 mg α-bergamotene, 6 mg β-bisabolene, 6 mg humulene, 10 mg β-farnesene, 10 mg germacrene D, 5 mg caryophyllene and 5 mg squalene.

TLC of fraction 2 ($Et_2O$–petrol, 1:4), three developments gave 15 mg **1**, 5 mg **4** and a mixture which gave by HPLC (RP 18,



|  | X | Y |
|---|---|---|
| **1** | $H_2$ | O |
| **2** | O | $H_2$ |



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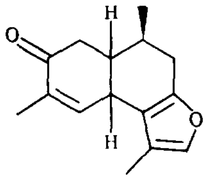

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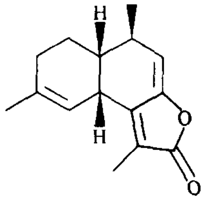
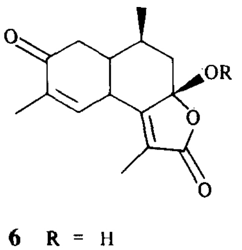
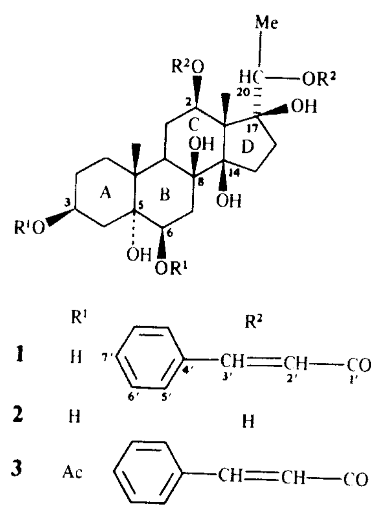


**5**



**6** R = H
**7** R = Me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20
2
C
17
D
OH
OH
A
B
8
14
3
5
R¹O
6
OH
OR¹
OH
R¹
R²
1
H
7'
4'
3'
2'
1'
6'
5'
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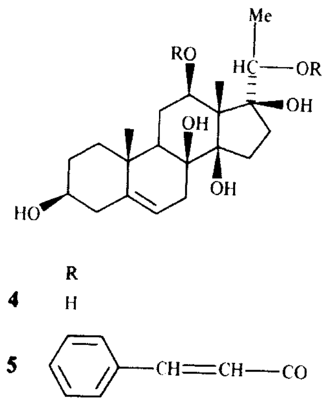
2
H
H
3
Ac
CH=CH—CO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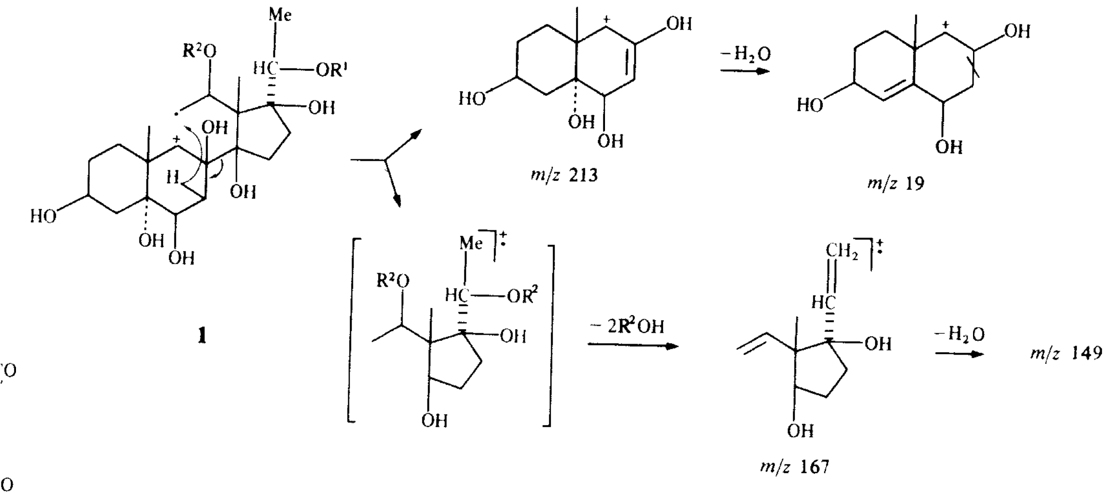
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HO
OH
OH
m/z 19
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HC
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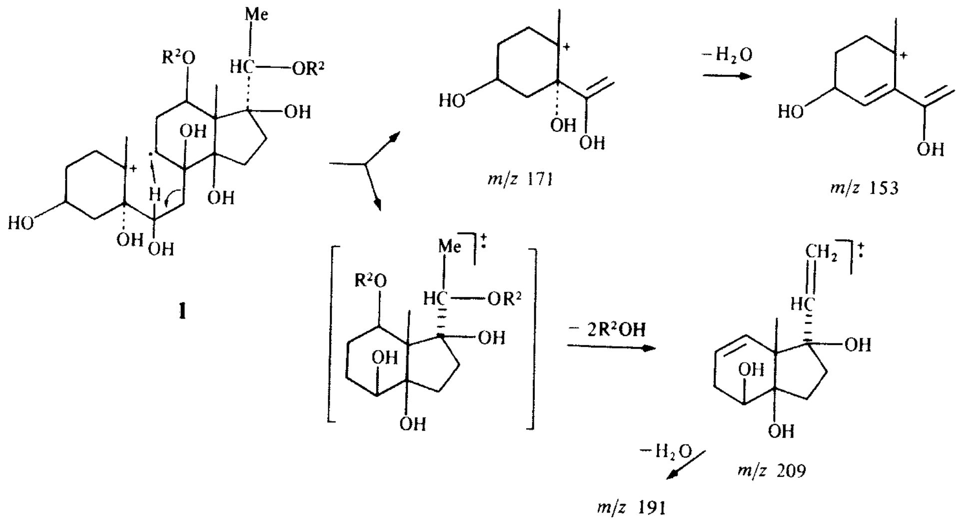
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OH
m/z 153
Me
R²O
HC—OR²
OH
OH
OH
− 2R²OH
CH₂
HC
OH
OH
OH
m/z 209
−H₂O
m/z 191

Table 1. $^1$H NMR spectral data of **2** and **4**–**7** (400 MHz, $CDCl_3$, *d*-values)

| | **2** | **4** | **5** | **6** | **7** |
|---|---|---|---|---|---|
| 1 | 2.80 *dd* | 2.77 *dd* | 1.95 *m* | 2.85 *dd* | 2.83 *dd* |
| | 2.59 *dd* | 2.58 *dd* | 1.68 *m* | 2.62 *dd* | 2.59 *dd* |
| 2 | — | — | 2.00 *m* | — | — |
| 2 | — | — | | — | — |
| 4 | 6.49 *ddq* | 6.57 *ddq* | 5.22 *br s* | 6.36 *br s* | 6.28 *br s* |
| 5 | 3.60 *br s* | 3.64 *br s* | 3.52 *br s* | 3.98 *br s* | 3.96 *ddq* |
| 6 | 2.00 *m* | 2.17 | 1.81 *m* | 1.89 *m* | 1.86 *m* |
| 7 | 1.82 *m* | 2.00 *m* | 2.53 *ddq* | 2.08 *m* | 2.02 *dddq* |
| 8 | 2.28 *ddd* | 2.67 *br dd* | 5.52 *d* | 2.33 *dd* | 2.44 *dd* |
| 8′ | 1.86 *m* | 2.23 *br dd* | | 1.44 *dd* | 1.31 *dd* |
| 9 | 5.94 *br s* | — | — | — | — |
| 12 | 5.02 *br s* | 7.08 *br s* | — | — | — |
| 12′ | 4.98 *br s* | — | — | — | — |
| 13 | 1.94 *br s* | 2.04 *d* | 1.94 *br s* | 1.92 *br s* | 1.97 *br s* |
| 14 | 0.97 *d* | 1.07 *d* | 1.08 *d* | 1.02 *d* | 1.02 *d* |
| 15 | 1.75 *dd* | 1.78 *dd* | 1.68 *br s* | 1.82 *br s* | 1.83 *dd* |

*J*(Hz): compound **2**: 1,1 = 15.5; 1,6 = 2.5; 1′, 6 = 5; 4,5 = 4, 6 = 4, 15 ≈ 1.5; 5,15 = 2.5; 7, 14 = 6.5; 7,8 = 8, 9 = 4; 8,8′ = 17; compound **4**: 1,1 = 15.5; 1,6 = 1′,6 = 5, 6 = 6, 7 = 4.5; 4,15 = 5, 15 = 2; 4,6 = 1; 7,8 = 5; 7,8′ = 9; 7,14 = 6.5; 8,8′ = 16.5; 12,13 = 1.5; compound **5**: 6,7 = 7,14 = 7; 7,8 = 3.5; compound **6** and **7**: 1,1′ = 16; 1,6 = 2.5; 1,6′ = 5; 4,5 = 5.6 = 5, 15 = 2.5; 4,15 = 1.5; 6,7 = 7,8′ = 12; 7,8 = 3.5; 7,14 = 7; 8,8′ = 13.5.

$MeOH$–$H_2O$, 4:1), 5 mg **5** ($R_t$ 12.7 min), 3 mg **1** and 3 mg **2** ($R_t$ 15.0 min). HPLC of fraction 3 ($MeOH$–$H_2O$, 3:2) gave 6 mg *p*-hydroxybenzylalcohol, 8 mg *p*-hydroxybenzaldehyde, 4 mg **6** ($R_t$ 5.5 min) and 8 mg **7** ($R_t$ 7.0 min). TLC of fraction 4 ($CH_2Cl_2$) gave 8 mg bornyl ferulate. Known compounds were identified by comparing the 400 MHz $^1$H NMR spectrum with those of authentic material.

8-*Oxo*-9,12-*dehydroverboccidentene* (**2**). Colourless oil, IR $\nu$ $cm^{-1}$ ($CCl_4$) 1680 ($C{=}CC{=}O$); MS: *m/z* (rel. int.) 216 (8) $(M)^+$, 201 (5) $[M - Me]^+$, 159 (55) $[201 - C_3H_6]^+$, 145 (100) $[M - C_5H_{11}]^+$; $[\alpha]_D = +5.5$ ($CHCl_3$).

2-*Oxoverboccidentafurane* (**4**). Colourless oil, IR $\nu$ $cm^{-1}$ ($CCl_4$) 1670 ($C{=}CC{=}O$); MS: *m/z* (rel. int.) 230.131 (100) $(M)^+$ (calc. for $C_{15}H_{18}O_2$ 230.131), 215 (10). 188 (71), 187 (43), 173 (47).

8,9-*Dehydroverboccidentalactone* (**5**). Colourless oil, IR $\nu$ $cm^{-1}$ ($CCl_4$) 1760 (lactone); MS: *m/z* (rel. int.) 230.130 (14) $(M)^+$ (calc. for $C_{15}H_{18}O$, 230.130), 215 (9), 177 (28), 175 (30), 174 (100). $[\alpha]_D$ +4($CHCl_3$).

9-*Hydroxyverboccidentalactone* (**6**). Colourless oil, IR $\nu$ $cm^{-1}$ ($CCl_4$) 1760 (lactone), 1680 ($C{=}CC{=}O$); MS: *m/z* (rel. int.) 244.110 (24) $(M - H_2O)^+$ (calc. for $C_{15}H_{16}O_3$ 244.110), 109 (100), 91 (52) $[\alpha]_D = +7$($CHCH_3$).

9-*Methoxyverboccidentalactone* (**7**). Colourless gum, IR $\nu$ $cm^{-1}$ ($CCl_4$) 1780 (lactone), 1690 ($C{=}CC{=}O$); MS: *m/z* (rel. int.) 276.136 (2) $(M)^+$ (calc. for $C_{16}H_{20}O_4$ 276.136), 224 (4.5) $[M - MeOH]^+$, 135 (8), 57 (100).

## REFERENCES

1. Bohlmann, F., Knoll, K. H., Robinson, H. and King, R. M. (1980) *Phytochemistry* **19**, 107.
2. Bohlmann, F., Knoll, K. H., Robinson, H. and King R. M. (1980) *Phytochemistry* **19**, 107.
3. Herz, W. and Bhat, S. V. (1970) *J. Org. Chem.* **35**, 2605.
4. Herz, W. and Bhat, S. V. (1973) *Phytochemistry* **19**, 115.
5. Bohlmann, F. and Lonitz, M. (1978) *Phytochemistry* **17**, 453.
6. Bohlmann, F. and Gupta, R. K. (1981) *Phytochemistry*, **20**, 1432.