Pergamon

PII: S0031-9422(97)01053-4

Phytochemistry, Vol. 48, No. 6, pp. 1071–1073, 1998

Printed in Great Britain
0031 9422/98 $19.00+0.00

4′-DEMETHYLKNIPHOLONE FROM AERIAL PARTS OF *BULBINE CAPITATA*

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(*Received* 27 *September* 1997)

Key Word Index—*Bulbine capitata*; Asphodelaceae; aerial parts; anthraquinones; 4′-demethylknipholone.

Abstract—4′-Demethylknipholone was isolated from the aerial parts of *Bulbine capitata* (Asphodelaceae) in addition to the known compounds, chrysophanol, knipholone, isoknipholone, foliosone, 5,8-dihydroxy-1-hydroxymethylnaphtho[2,3-c]furan-4,9-dione, apigenin and luteolin. The structures were determined on the basis of spectroscopic data. © 1998 Elsevier Science Ltd. All rights reserved

INTRODUCTION

Bulbine capitata V. Poelln (synonym *B. stenophylla* Verdurn), Asphodelaceae, is one of six *Bulbine* species recorded in Botswana [1, 2]. We have recently reported the isolation of anthraquinones, isofuranonaphthoquinones and a phenol derivative from the roots of *B. capitata* [3]. In continuation of the study on the chemistry of this species, we examined its aerial parts and in this paper we wish to report the isolation of the new plant metabolite, 4′-demethylknipholone (**1**) in addition to seven known compounds.

RESULTS

Compound **1** ($[\alpha]_D$ +104) was obtained as dark red solid. HRMS measurement showed an exact mass of 420.0835 ($C_{23}H_{16}O_8$). The UV-vis spectrum showed maxima at 202, 224, 254, 287 and 430 nm. The IR spectrum displayed an hydroxyl absorption at 3424 cm^{-1}, chelated and unchelated carbonyl bands at 1623 and 1675 cm^{-1}, respectively. The ^1H NMR spectrum of **1** showed singlet signals for three chelated hydroxyls at δ 13.79, 12.44 and 11.85 and an isolated and shielded aromatic proton at δ 6.11 which are typical of knipholone type structure. The ^1H NMR spectrum exhibited additional signals for two phenolic hydroxyl groups at δ 10.87 and 10.19, an aromatic methyl at δ 2.08, and an acetyl methyl at δ 2.61. An ABC system was also observed at δ 7.49 (*dd*, J = 7.97, 1.07 Hz), 7.74 (*t*, J = 7.97 Hz) and 7.32 (*dd*, J = 7.97, 1.07 Hz) which were assigned to H-5, H-6 and H-7, respectively. A broad singlet at δ 7.34 was assigned to H-2.

The ^{13}C NMR spectrum of **1** displayed a total of 23 signals. DEPT experiment revealed the presence of two methyl, five methine and sixteen quaternary carbons. All of the ^{13}C NMR signals were characteristic of unsaturated carbons with the exception of the aromatic and acetyl methyl signals at δ 20.4 and 32.5, respectively. The quaternary signals at δ 202.6, 192.0 and 181.9 suggested the presence of three carbonyl groups. The presence of five oxygenated quaternary aromatic carbons was also observed from the signals at δ 162.1, 161.5, 161.4, 161.2 and 160.7 in the ^{13}C NMR spectrum. The signal at δ 94.5 was assigned to C-5′ which has oxygen substitutions on both *ortho* positions. The ^1H NMR of **1** was characterized by the absence of a methoxyl resonance when compared with the ^1H NMR spectrum of knipholone (**2**). Further comparison of the MS of **1** with that of knipholone indicated that **1** is 14 amu less then knipholone. These observations led to the conclusion that **1** is a demethyl derivative of knipholone. The co-occurrence of **1** with knipholone and isoknipholone suggests that it may be the biogenetic precursor of **2** and **3**. In view of the medicinal use of the plant and the current interest on the biological activity of chiral biaryls, **1** was submitted to *in vitro* antiviral test but was inactive.

Foliosone (**4**), was reported only recently from *Kniphofia foliosa* and the spectroscopic data generated for **4** are in agreement with those reported for foliosone [4]. ^{13}C NMR data for **4** are presented here for the first time. Chrysophanol, knipholone (**2**), isoknipholone (**3**), and 5,8-dihydroxy-1-hydroxymethylnaphtho[2,3-c]furan-4,9-dione (**5**) were identified from their NMR, MS, UV-vis and IR spectral data as well as from direct TLC comparison with authentic specimens isolated

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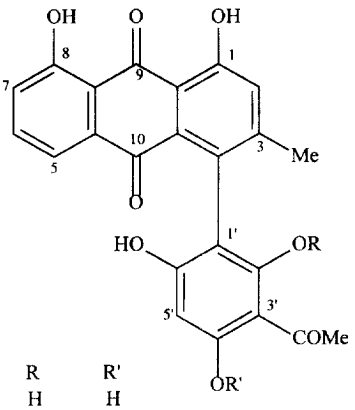
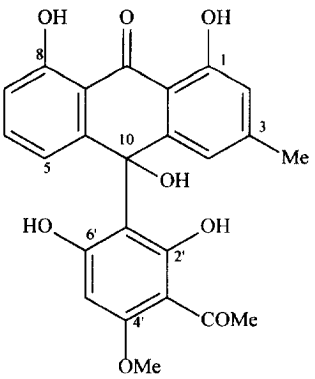


	R	R'
1	H	H
2	H	Me
3	Me	H



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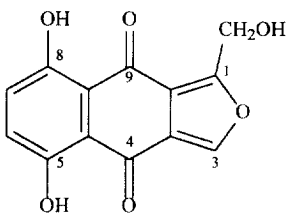

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from the roots of the same plant. The identity of the two flavonoids as apigenin and luteolin was also readily established from their spectroscopic data. It is noted that flavonoids have not been reported from the genus *Bulbine*, previously.

EXPERIMENTAL

General

Mp: uncorr. FT-IR: KBr discs. ^{1}H NMR at 300 MHz, ^{13}C NMR at 75.5 MHz and chemical shifts were referenced to the residual solvent peaks. Analytical TLC: Merck, Kieselgel 60 F_{254}, 0.25 mm. Flash CC: silica gel, Merck, Kieselgel 60, particle size 0.040–0.063 m impregnated with 5% aq. oxalic acid. Prep. TLC: silica gel, Merck, Kieselgel 60 $F_{254+366}$, 0.5 or 0.75 mm.

Plant material

Collection and identification of plant material is documented [3].

Extraction and isolation

445 g of air-dried and powdered aerial parts of *B. capitata* were successively extracted with 2 l CH_2Cl_2–MeOH 1:1 mixture overnight and 1.5 l MeOH for 20 minutes at room temperature. The combined extract was freed of solvent *in vacuo* ($\leq 40°$) to yield 54 g black gummy residue which was subsequently subjected to flash silica gel CC. The following solvents were used to collect a total of 20 frs each ca 250 ml. $CHCl_3$ (frs 1–10), $CHCl_3$–EtOAc 1:1 (frs 11–13), EtOAc (frs 14–16) and EtOAc–MeOH 4:1 (frs 17–20). TLC monitoring showed that frs 1 and 4 contain no interesting compounds and were discarded. Frs 2 and 3 were combined, applied on Sephadex LH-20 ($CHCl_3$–MeOH, 2:1) and further purified on prep. TLC (C_6H_6–hexane 9:1) to yield 3 mg of chrysophanol. Frs 5–10 were pooled together, filtered through Sephadex LH-20 and prep. TLC (C_6H_6–2% HCl in MeOH 4:1) of the various fractions obtained, afforded 8.2 mg foliosone (**4**), 14.6 mg knipholone (**2**), 3.7 mg isoknipholone (**3**) and 3.2 mg 5,8-dihydroxy-1-hydroxymethylnaphtho[2,3-c]furan-4,9-dione (**5**). Fr. 11 was applied on Sephadex LH-20 column (MeOH–$CHCl_3$, 1:2) and the resulting fractions were submitted to prep. TLC ($CHCl_3$–EtOAc–2% HCl in MeOH 80:20:3) to yield 80.8 mg 4′-demethylknipholone (**1**) and 60.0 mg apigenin. Frs 12–14 were pooled together and treated with $CHCl_3$. The $CHCl_3$ insoluble portion turned out to be 196.8 mg luteolin.

4′-Demethylknipholone (**1**). Dark red solid; mp 210–212° (dec.) $[\alpha]_D$ +104° (*c* 0.02 MeOH); found $[M]^+$ 420.0835 $C_{23}H_{16}O_8$ requires 420.0843; UV-vis λ_{max} (MeOH) nm (log ε): 202 (4.4), 224 (4.6), 254 (4.4), 287 (4.4), 430 (4.0); IR ν_{max} KBr cm^{-1}: 3424,1675, 1623; EIMS (probe) 70 eV, *m/z* (rel. int.) 420 $[M]^+$ (100), 405 (14), 267 (16), 256 (19), 171 (42); ^{1}H NMR (300 MHz, DMSO-d_6): δ 13.79 (1H, *s*, OH), 12.44 (1H, *s*, OH) 11.85 (1H, *s*, OH), 10.87 (1H, *s*, OH), 10.19 (1H, *s*, OH), 7.74 (1H, *t*, *J* = 7.97 Hz, H-6), 7.49 (1H, *dd*, *J* = 7.97, 1.07 Hz, H-5), 7.34 (1H, *br s*, H-2), 7.32 (1H, *dd*, *J* = 7.97, 1.07 Hz, H-7), 6.11 (1H, *s*, H-5′), 2.61 (3H, *s*, Ar-COMe), 2.08 (3H, *s*, Ar-Me); ^{13}C NMR

(75.5 MHz, DMSO-d_6) δ 202.6 (*s*, Ar-CO-Me), 192.0 (*s*, C-9), 181.9 (*s*, C-10), 162.1, 161.5, 161.4, 161.2, 160.7 (all *s*, C-1, C-8, C-2′, C-4′, C-6′), 151.4 (*s*, C-3), 137.3 (*d*, C-6), 134.2 (*s*, C-10a), 131.3 (*s*, 4a), 128.7 (*s*, C-4), 124.4 (*d*, C-2), 123.4 (*d*, C-7), 119.1 (*d*, C-5), 115.4 (*s*, C-8a), 114.5 (*s*, 9a), 105.8 (*s*, C-3′), 104.0 (*s*, C-1′), 94.5 (*d*, C-5′), 32.5 (*q*, Ar-COMe), 20.4 (*q*, Ar-Me).

Foliosone (**4**). Yellow solid; mp 225–227°; $[\alpha]_D$ −62.5 (*c* 0.02, $CHCl_3$) UV-vis λ_{max} ($CHCl_3$ nm (log ε): 207 (4.0), 270 (3.5), 309 (3.7), 381 (3.3); IR ν_{max} cm^{-1}: 3418, 1617; EIMS (probe) 70 eV, *m/z* (rel. int.): 436 $[M]^+$ (9), 418 $[M-H2O]^+$ (97), 403 $[M-H2O-CH3]^+$ (100); ^1H NMR (300 MHz, $CDCl_3$): δ 14.08 (1H, *s*, OH), 12.32 (1H, *s*, OH), 12.27 (1H, *s*, OH), 11.28 (1H, *br s*, OH), 7.40 (1H, *t*, *J* = 8.02 Hz, H-6), 7.06 (1H, *dd*, *J* = 8.02, 1.03 Hz, H-5), 6.87 (1H, *br s*, H-4), 6.78 (1H, *dd*, *J* = 8.02, 1.03 Hz, H-7), 6.60 (1H, *br s*, H-2), 6.03 (1H, *s*, H-5′), 4.58 (1H, *br s*, OH), 3.89 (3H, *s*, OMe), 2.45 (3H, *s*, Ar-CO-Me), 2.29 (3H, *s*, Ar-Me); ^{13}C NMR (75.5 MHz, $CDCl_3$): δ 202.8 (*s*, Ar-CO-Me), 192.2 (*s*, C-9), 164.1, 163.7, 162.5, 161.7, 161.5 (all *s*, C-1, C-8, C-2′, C-4′, C-6′), 149.1 (*s*, C-3), 147.6, 147.5 (all *s*, C-4a, C-9a), 136.9 (*d*, C-6), 120.3, 119.0, 117.8, 117.5 (all *d*, C-2, C-4, C-5, C-7), 113.8 111.6 (all *s*, C-9a, C-8a), 108.6 (*s*, C-1′), 105.2 (*s*, C-3′), 91.9 (*d*, C-5′), 76.6 (in acetone-d_6 *s*, C-10), 55.6 (*q*, OMe), 32.8 (*q*, Ar-COMe), 22.4 (*q*, Ar-Me).

Acknowledgements—Dr M. M. Nindi is thanked for MS measurements and we are grateful to NCI for antiviral activity test. MB acknowledges DAAD scholarship.

REFERENCES

1. Reid, C., in *Plants of Southern Africa: Names and Distribution*, ed. T. H. Arnold and B. C. de Wett. National Botanical Institute, Pretoria, 1993, p. 133.
2. Turton, L. M. and Kalake, E., *A List of the Flowering Plants of Botswana in the Herbaria at the National Museum, Sebele and University of Botswana*, The Botswana Society and The National Museum, Monuments and Art Gallery, Gaborone, 1994, p. 46.
3. Bezabih, M., Motlhagodi, S. and Abegaz, B. M., *Phytochemistry*, 1997, **46**, 1063.
4. Yenesew, A., Muller, M., Steglich, W. and Dagne, E., *Phytochemistry*, 1994, **37**, 525.