A Novel Dimeric Butenolide, Glochidiolide, from the Leaves of *Glochidion Acuminatum* MUELL

Hideaki OTSUKA,*[,a] Kaori KOTANI,[a] Masahiko BANDO,[b] Masaru KIDO,[b] and Yoshio TAKEDA[c]

Institute of Pharmaceutical Sciences, Hiroshima University School of Medicine,[a] 1-2-3 Kasumi, Minami-ku, Hiroshima 734-8551, Japan, Second Tokushima Institute of New Drug Research, Otsuka Pharmaceutical Co., Ltd,[b] Kagasuno, Kawauchi-cho, Tokushima 770-0130, Japan, and Faculty of Integrated Arts and Sciences, The University of Tokushima,[c] 1-1 Minamijosanjima-cho, Tokushima 770-8502, Japan. Received May 11, 1998; accepted June 6, 1998

A novel dimeric butenolide called glochidiolide was isolated from the leaves of *Glochidion acuminatum*. Its structure was elucidated by X-ray analysis.

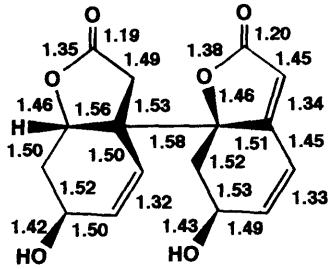
Key words *Glochidion acuminatum*; Euphorbiaceae; X-ray analysis; dimeric butenolide; glochidiolide

In the course of our studies on plants collected on Okinawa, a novel dimeric butenolide, glochidiolide (**1**) (200 mg), was isolated from the leaves (2.38 kg) of *Glochidion acuminatum* (Euphorbiaceae)[1] by MeOH extraction, separation of the 1-BuOH-soluble fraction of the MeOH extract using a highly porous synthetic resin (Diaion HP-20), and silica gel column chromatographies.

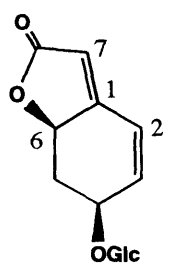
Glochidiolide (**1**) was isolated as colorless rods of which the elemental composition was determined to be $C_{16}H_{16}O_6$ by HR negative-ion FAB mass spectrometry from the observation of a quasimolecular ion peak at *m/z* 303.0855.[2] The IR spectrum demonstrated the presence of double bonds (1625 cm^{-1}), and two different types of carbony groups (1750 and 1725 cm^{-1}). The ^{13}C-NMR spectral data (100 MHz) revealed the presence of 16 carbon atoms which comprised two disubstituted and one trisubstituted double bonds, and two carbonyl, three methine, three methylene, and two quaternary carbon atoms. Close inspection of the two-dimensional NMR spectra, including ^1H–^1H correlation spectroscopy (COSY) and heteronuclear single quantum coherence spectroscopy (HSQC), only a partial structure could be elucidated. The use of the heteronuclear multiple-bond correlation (HMBC) spectrum also did not succeed in elucidating the entire structure, because of the appearance of enormous long-range coupling cross-peaks due to the presence of double bonds. Finally, X-ray analysis was performed to determine the structure of **1**.

An isolated crystal was suitable for X-ray analysis and the structure was determined by means of the direct method using the TEXSAN crystallographic software package.[3] The structure of **1** is shown with bond lengths (Å) and a computer-generated perspective drawing is shown in Fig. 1. As a result, glochidiolide (**1**) was found to be a novel dimeric butenolide, with monomers being connected to each other at the 1- and 6-positions. However, the absolute configurations of the symmetric carbon atoms remain to be determined. It is noteworthy that the 6-position of each half has a different arrangement of substituents.

Similar monomeric butenolides have been isolated from several plant sources.[4] Recently, a glucoside of which the aglycone has a similar structure to one half of glochidiolide, phyllanthurinolactone (**2**), was isolated from a nyctinastic plant, *Phyllanthus urinaria* (Euphorbiaceae), as a bioactive substance that controls the level of indole acetic acid for nyctinacy.[5] The absolute chemistry of phyllanthurinolactone was determined by X-ray analysis of a stereospecifically controlled synthetic compound.[6]



1



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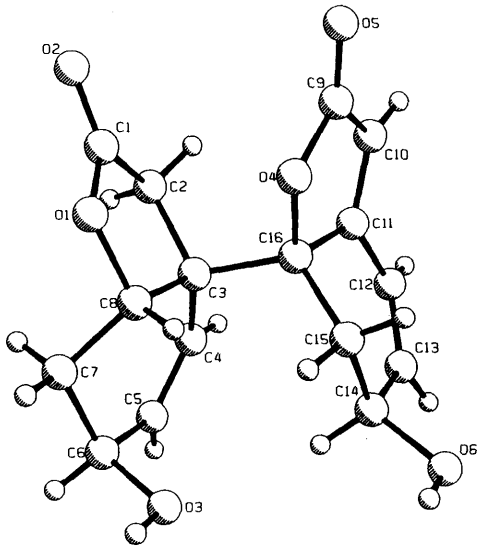

Fig. 1. A Computer-Generated Perspective Drawing of **1**

* To whom correspondence should be addressed.

A diastereomeric compound, with an aglycone in the enantiomeric structure, was reported to show no activity. Recently, butenolides have become targets for synthetic work in studies on the mechanisms of these compounds in the circadian rhythm in plants.[6]

References and Notes

1) Plant material was identified as *Glochidion acuminatum* by Mr. Anki Takushi of Okinawa Prefectural Experimental Station of Forestry, whom the authors grately acknowledge.

2) Glochidionolide (**1**): Colorless rods, mp 210—213 °C, $[\alpha]_D^{25}$ −69.8° (c=0.49, DMSO). IR ν_{max} (KBr): 3400, 3050, 1750, 1725, 1625, 1450, 1420, 1355, 1290, 1265, 1195, 1055, 1020, 1050, 975, 925 and 890 cm^{-1}; UV λ_{max} (MeOH): 256 (4.17) nm (log ε); ^{1}H-NMR (DMSO-d_6 + two drops of D_2O) δ: 1.60 (1H, dd, J=10, 13 Hz, H-15a), 1.77 (1H, ddd, J=2, 9, 14 Hz, H-7a), 2.26 (1H, d, J=17 Hz, H-2a), 2.39 (1H, dt, J=5, 14 Hz, H-7b), 2.48 (1H, d, J=17 Hz, H-2b), 2.93 (1H, dd, J=6, 13 Hz, H-15), 4.09 (1H, t, J=7 Hz, H-6), 4.53 (1H, ddd, J=2, 7, 9 Hz, H-14), 4.86 (1H, br s, H-8), 5.55 (1H, br d, J=10 Hz, H-4), 5.91 (1H, br d, J=10 Hz, H-5), 6.19 (1H, s, H-10), 6.20 (1H, dd, J=5, 10 Hz, H-13), 6.79 (1H, td, J=1, 10 Hz, H-12). ^{13}C-NMR (DMSO-d_6) δ: 33.5 (C-7), 37.1 (C-2), 41.7 (C-15), 47.6 (C-3), 59.8 (C-6), 63.8 (C-14), 78.0 (C-8), 86.9 (C-16), 113.9 (C-10), 121.7 (C-12), 124.9 (C-4), 134.8 (C-5), 142.6 (C-13), 165.3 (C-11), 170.6 (C-9), 173.5 (C-1). HR negative-ion FAB MS m/z : 303.0855 (calcd for $C_{16}H_{15}O_6$: 303.0868). *Anal.* Calcd for $C_{16}H_{16}O_6$: C, 63.15; H, 5.30. Found: C, 62.97; H, 5.35.

3) Crsytal data; **1**: monoclinic, space group $P2_1$, a=5.835 (5) Å, b=14.649 (8) Å, c=8.136 (7) Å, β=97.80 (7)°, V=691.1 (8) Å^3, Z=2, Dx=1.462 g/cm^3, $F(000)$=320, μ(MoKα)=1.05 cm^{-1}. No. of RD=1407, No. of F_{obs}=1161, R=0.049, Rw=0.056. The structure was determined by means of the direct method using the TEXSAN crystallographic software package.[7]

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7) "TEXSAN, TEXRAY Structure Analysis Package," Molecular Structure Corporation, 3200 Research Forest Drive, The Woodlands, TX 77381, U.S.A., 1985.