Isolation and Absolute Structures of the Neolignan Glycosides with the Enantiometric Aglycones from the Leaves of *Viburnum awabuki* K. KOCH[1)]

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Two neolignan glycosides, dihydrodehydrodiconiferyl alcohol 4-*O*-β-D-glucopyranosides with the enantiometric aglycones (1 and 2), have been isolated from the leaves of *Viburnum awabuki* K. KOCH. These structures were identified by spectroscopic evidence and the absolute configurations of these compounds were elucidated on the basis of circular dichroism data.

Key words *Viburnum awabuki*; Caprifoliaceae; neolignan glycoside; CD

In the chemical study of *Viburnum awabuki* K. KOCH, a fish poison plant, a number of constituents such as vibsanines,[2)] coumarin glycosides and triterpenoids[3)] were isolated. In a previous paper, we reported the isolation of flavonoid glycosides[4)] from the leaves of this plant. As a part of continuing studies on the constituents of the genus *Viburnum* (Caprifoliaceae), we now report the isolation and elucidation of the absolute structures of two dihydrodehydrodiconiferyl alcohol 4-*O*-β-D-glucopyranosides with enantiometric aglycones.

The isolation and purification of the compounds are described in detail in the Experimental section.

Compound **1** was obtained as an amorphous powder, $[\alpha]_D$ −6.9°. The ^{1}H-NMR spectrum of **1** exhibited trimethylene proton signals [δ 1.81 (2H, m), 2.62 (2H, t), 3.56 (2H, t)], two methoxyl group signals [δ 3.83 (3H, s), 3.86 (3H, s)], a methine proton signal [δ 5.56 (1H, d, J=5.9 Hz)] and five aromatic proton signals at δ 6.72—7.14. In the ^{13}C-NMR spectrum, the presence of a dihydrobenzofuran skeleton and a glucose were suggested. The nuclear Overhauser effect correlation spectroscopy (NOESY) spectrum showed a cross peak between the glucosyl anomeric proton and the H-5 at the *ortho*-position, so that it was apparent that the glucosyl moiety is attached to the C-4 hydroxyl group. From the $J_{H7,H8}$ (5.9 Hz) coupling constant of **1**, it was exhibited that the configuration of H-7 and H-8 was *trans*.

Absolute configurations were assigned on the basis of circular dichroism (CD) spectroscopic evidence. The CD spectrum of **1** showed the transition at 239 and 221 nm with opposite signs, that is, **1** has a negative Cotton effect at 239 nm and a positive one at 221 nm. Compound **1** shows UV maxima at 277 nm, however, the CD absorption corresponding to this band was very low. Lemiere *et al.* reported that the configurations at C-7 and C-8 of the dihydrobenzofuran skeleton can be clearly distinguished from the 240—220 nm region.[5)] Therefore, the absolute configurations of **1** were determined to be 7*R*,8*S*-configurations.

7*R**,8*S**-dihydrodehydrodiconiferyl alcohol 4-*O*-β-D-glucopyranoside was isolated from *Epimedium diphyllum* by Miyase *et al.*, but its absolute configurations were not elucidated completely.[6)]

Compound **2** was obtained as an amorphous powder, $[\alpha]_D$ −33.4°. Interestingly, the ^{1}H- and ^{13}C-NMR spectra of **2** were very similar to those of **1**; the structure of **2** was identified to be dihydrodehydrodiconiferyl alcohol 4-*O*-β-D-glucopyranoside by spectroscopic analysis. Accordingly, the aglycone parts of **1** and **2** were deduced to be enantiometric structures, as shown in Chart 1.

In contrast with the CD spectrum of **1**, **2** had a positive Cotton effect at 242 nm and a negative one at 221 nm.

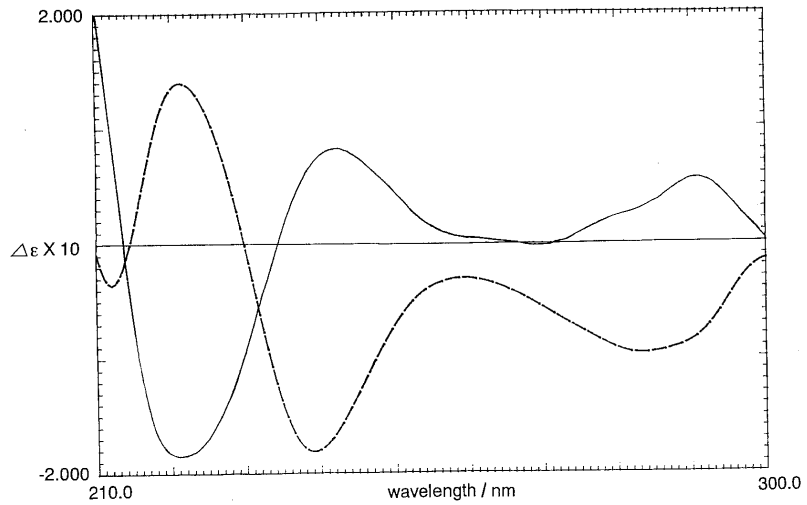

Fig. 1. CD Spectra of Compounds **1** (– – –) and **2** (——) in H_2O
1 = 3.0 × 10^{-5} mol/l; **2** = 2.0 × 10^{-5} mol/l.

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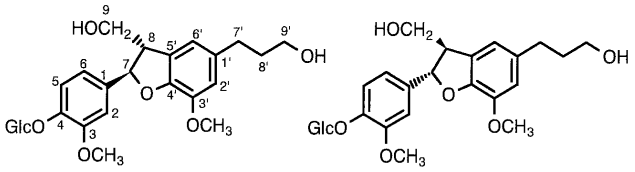

1 2

Chart 1

Therefore, the absolute configurations of **2** were determined to be 7*S*,8*R*-configurations.

Compound **2**, which has an enantiomer of **1** as its aglycone moiety, is a new natural compound.

This is the first example of the isolation of dihydrodehydrodiconiferyl alcohol 4-*O*-*β*-D-glucopyranosides (**1** and **2**) with the enantiometric aglycone, and is the unambiguous determination of the absolute structures of these compounds.

Experimental

Optical rotations were determined with a JASCO DIP-360 digital polarimeter. UV spectra were recorded with a Beckman DU-64 spectrometer. CD spectra were recorded with a JASCO J-700 spectropolarimeter. ^{1}H- and ^{13}C-NMR spectra were recorded with a JEOL JNM-GSX 400 (400 and 100 MHz, respectively) or 270 (270 and 67.8 MHz, respectively) spectrometer. Chemical shifts are given on a δ (ppm) scale with tetramethylsilane as an internal standard (s, singlet; d, doublet; t, triplet; dd, double doublet; m, multiplet). Column chromatography was carried out on Kieselgel 60 (Merck; 230—400 mesh) and Sephadex LH-20 (Pharmacia Fine Chemicals). Preparative HPLC was carried out on a Tosoh HPLC system (pump, CCPM; detector, UV-8000) using a TSK gel ODS-120A (Tosoh) column.

Extraction and Isolation Fresh leaves of *V. awabuki* (4 kg), collected in October 1993 in Sendai, Japan, were extracted with MeOH at room temp. for 1 month. The MeOH extract was concentrated *in vacuo* and the residue was suspended in water. The water layer was successively extracted with $CHCl_3$, Et_2O, AcOEt and *n*-BuOH. The BuOH-soluble part (30 g) was chromatographed on a Sephadex LH-20 column (MeOH–H_2O, 1 : 1), and then an ODS column. The MeOH–H_2O (1 : 4) eluate was purified by a silica gel column ($CHCl_3$–MeOH–H_2O, 30 : 10 : 1), and then subjected to prep. HPLC [ODS-120A 7.8 mm i.d. × 30 cm, MeOH–H_2O (1 : 3)] to give **1** (5 mg) and **2** (3 mg).

Compound 1 Amorphous powder. $[\alpha]_D$ −6.9° (c=0.4, MeOH). IR ν_{max}^{KBr} cm^{-1}: 3344, 1605, 1518. UV λ_{max}^{MeOH} nm (log ε): 226 (3.9), 277 (3.4). FAB-MS m/z: 523 $[M+H]^+$. CD nm ($\Delta\varepsilon$): 221 (+13.90), 239 (−18.15), 283 (−9.70). ^{1}H-NMR (CD_3OD, 270 MHz) δ: 1.81 (2H, m, H-8′), 2.62 (2H, t, H-7′), 3.56 (2H, t, H-9′), 3.83 (3H, s, OCH_3 at C-3), 3.86 (3H, s, OCH_3 at C-3′), 5.56 (1H, d, J=5.9 Hz, H-7), 6.72 (2H, d, J=1.9 Hz, H-2′ and H-6′), 6.93 (1H, dd, J=1.9, 8.5 Hz, H-6), 7.03 (1H, d, J=1.9 Hz, H-2), 7.14 (1H, d, J=8.5 Hz, H-5). ^{13}C-NMR (CD_3OD, 67.8 MHz) δ: 32.9 (C-7′), 35.8 (C-8′), 55.6 (C-8), 56.7 and 56.8 (OCH_3 × 2), 62.2 (C-9′), 62.5 (C-6″), 65.1 (C-9), 71.3 (C-4″), 74.4 (C-2″), 77.8 (C-5″), 78.2 (C-3″), 88.5 (C-7), 102.8 (C-1″), 112.2 (C-2), 114.3 (C-2′ or C-6′), 118.0 (C-2′ or C-6′), 118.2 (C-5), 119.4 (C-6), 129.6 (C-5′), 137.1 (C-1′), 138.4 (C-1), 145.2 (C-3′), 147.5 (C-4 or C-4′), 147.6 (C-4 or C-4′), 150.9 (C-3).

Compound 2 Amorphous powder. $[\alpha]_D$ −33.4° (c=0.7, MeOH). IR ν_{max}^{KBr} cm^{-1}: 3344, 1605, 1518. UV λ_{max}^{MeOH} nm (log ε): 227 (4.0), 277 (3.4). FAB-MS m/z: 523 $[M+H]^+$. CD nm ($\Delta\varepsilon$): 221 (−18.61), 242 (+8.14), 290 (+5.49). ^{1}H-NMR (CD_3OD, 400 MHz) δ: 1.80 (2H, m, H-8′), 2.62 (2H, t, H-7′), 3.56 (2H, t, H-9′), 3.83 (3H, s, OCH_3 at C-3), 3.86 (3H, s, OCH_3 at C-3′), 5.55 (1H, d, J=5.9 Hz, H-7), 6.71 (1H, d, J=1.8 Hz, H-2′), 6.73 (1H, d, J=1.8 Hz, H-6′), 6.93 (1H, dd, J=1.8, 8.4 Hz, H-6), 7.03 (1H, d, J=1.8 Hz, H-2), 7.14 (1H, d, J=8.4 Hz, H-5). ^{13}C-NMR (CD_3OD, 100 MHz) δ: 32.9 (C-7′), 35.9 (C-8′), 55.7 (C-8), 56.7 and 56.8 (OCH_3 × 2), 62.3 (C-9′), 62.5 (C-6″), 65.1 (C-9), 71.4 (C-4″), 74.9 (C-2″), 77.9 (C-5″), 78.2 (C-3″), 88.5 (C-7), 102.8 (C-1″), 111.2 (C-2), 114.2 (C-6′), 118.0 (C-5 or C-2′), 118.2 (C-5 or C-2′), 119.4 (C-6), 129.6 (C-5′), 137.1 (C-1′), 138.4 (C-1), 145.3 (C-3′), 147.5 (C-4 or C-4′), 147.7 (C-4 or C-4′), 151.0 (C-3).

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References and Notes

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