Sesinoside, a New Iridoid Glucoside from Sesame (Sesamum indicum) Seedlings

<table>
<thead>
<tr>
<th>著者別名</th>
<th>山田 小須弥・繁森 英幸</th>
</tr>
</thead>
</table>
| 物語物名 | 薬学研究 薬科大学薬学部薬学科
| 各類别名 | 薬学研究 薬科大学薬学部薬学科
| 命名 | 薬学研究 薬科大学薬学部薬学科
| 資料 | 薬学研究 薬科大学薬学部薬学科
| 権利 | 薬学研究 薬科大学薬学部薬学科

(© 2014 Natural Product Inc.)

This is a preprint of an article published in Natural Product Communications 9 (11) 2014

URL: [http://hdl.handle.net/2241/00122853](http://hdl.handle.net/2241/00122853)
Iridoid glucosides (1) were isolated from the seedlings of Sesamum indicum. The structure of 1 was elucidated by spectroscopic analyses and by methanalysis of 1, which produced the known compounds, phlorigidoside C (2) and (6β)-foliamentic acid methyl ester (3). This is the first report of an iridoid glucoside with 3.

Keywords: Sesinoseide, Iridoid glucosedes, Sesamum indicum, Seedling, Photosstress.

Sesinoseide (1) was obtained as an amorphous powder. The molecular formula of 1 was established as C_{27}H_{38}O_{13} by high-resolution electrospray ionization mass spectrometry (HRESI-MS, m/z 593.2217 [M + Na]^{+}, Δ+0.7 mmu). The IR spectrum exhibited absorption bands at 3398 cm\(^{-1}\) for the hydroxyl group, and 1705 cm\(^{-1}\) and 1635 cm\(^{-1}\) for δC=O unsaturated ester groups. The 13C NMR spectrum (Table 1) indicated the presence of 27 carbons, which were assigned to two ester carbonyl carbons at δC 154.4, 144.5, 139.5, 129.8, 127.4, and 126.1; nine oxygenated methine carbons at δC 108.6, 105.2, 79.6, 75.8, 75.2, 63.8, and 63.5; two oxygenated methylene carbons at δC 63.9 and 59.7; a methoxy carbon at δC 65.7; a methyl ester at δC 79.6; and 9 olefins, an iridoid skeleton, and one C=O, C=O, and C=O (Table 1). This is the first report of an iridoid glucoside with 3.

The 1H COSY spectrum of 1 implied connectivities of 1-H/6-H/9-H/5-H/6-H/7-H/1'-H/2'-H/3'-H/4'/H/5'-H/6'-H/7'-H/8'-H (Figure 2). The HMBC spectrum (Figure 2) showed the correlations of H-1/C-1'; H-3/C-1, C-4 and C-11; H-5/C-3, C-4 and C-11; H-6/H-1'; H-7/C-10; H-9/C-10; H-10/C-8 and C-9; H-12/C-11; H-3'/C-1'; C-2' and C-9'; H-7'/C-5' and C-10'; H-9'/C-1' and C-2'; and H-10'/C-5' and C-6'. According to the molecular formula of 1, there were nine degrees of unsaturation. Two carbonyl groups, three olefins, an iridoid skeleton, and one β-glucoside unit accounted for eight of those. The remaining degree of unsaturation was assumed to be due to an epoxide ring formed between C-7 and C-8, as inferred from the 13C NMR data (δC 63.8 and 63.5). Therefore, the constitution of 1 was deduced. The relative structure of 1 was deduced from a nuclear Overhauser enhancement spectroscopy (NOESY) spectrum of 1. The representative correlations are shown in Figure 2. In the NOESY spectrum, the
correlations of H-5”/H-8” and H-7”/H-10” were observed. Thus, the configuration of the C-6”/C-7” double bond was denoted as Z. The correlations of H-1/H-10, H-6/H-7, and H-7/H-10 suggested that the relative structure of sesinoside (1) was as was shown in Figure 1.

To determine the configuration of 1, a methanolysis reaction was applied to 1 (Figure 3). Sodium methoxide solution was added to a solution of 1 in anhydrous methanol at room temperature under N₂ for 6 h. Then, phlorigidoside C (2) and foliamentic acid methyl ester (3) were then derived in 34% and 46% yield, respectively. The ¹H and ¹³C NMR spectroscopic (Table) and ESI-MS data of 2 were identical with those of phlorigidoside C [9].

**Experimental**

**General experimental procedure:** Optical rotations, JASCO DIP-370 spectrometer; UV, HITACHI U-2000A spectrometer; IR, JASCO FT/IR-300 spectrometer; NMR, BRUKER Avance 500 spectrometer; ESI-MS, WATERS SYNAPT G2 mass spectrometer.

**Plant materials:** Sesame seeds were purchased from Fukutane K. K. (Fukuoi, Japan). Seeds were spread evenly on moist vermiculite in trays and incubated at 25°C in the dark for 3-4 days. The seedlings (hypocotyls length, ca. 3~4 cm) were then illuminated by white light (30-38 cm) and kept in the dark for 3-4 days. The seedlings were harvested, collected, and frozen at -80°C until use.

**Extraction and isolation:** All parts of the illuminated seedlings (73 g FW) were homogenized in a ketone (250 mL x 2). The homogenate was filtered and allowed to dry in vacuo at 40°C. The residue (0.95 g) was subjected to ODS CC (in vacuo at 40°C). The residue (0.95 g) was homogenized in acetone (250 mL x 2). The homogenate was filtered and allowed to dry in vacuo at 40°C. The residue (0.95 g) was subjected to ODS CC (φ 11 x 30 cm) with a MeOH/H₂O (2:8/4:6/6:8/2:10:0) stepwise gradient and EtOAc, and separated into 5 fractions (SIA-1~5). SIA4 (58.3 g) was purified by reversed-phase HPLC (TSK-gel ODS-80Ts, TOSOH, φ 7.8 x 300 mm, flow rate 2.0 mL/min, 30% MeCN isocratic) to yield sesinoside (1, 5.6 mg).

**Methanolysis reaction of sesinoside:** Sodium methoxide solution (0.5 N, 0.1 mL) was added to a solution of sesinoside (1, 5.0 mg, 8.8 x 10⁻³ mol) in anhydrous methanol (0.5 mL) and the mixture was stirred at room temperature under N₂ for 6 h. After 6 h, HCl (1 N, 0.12 mL) was added to stop the reaction. The reaction mixture was partition with EtOAc (10 mL) and H₂O (10 mL). The EtOAc layer was dried with MgSO₄, and both layers were evaporated. Water layer was purified by reversed-phase HPLC (TSK-gel ODS-80Ts, TOSOH, φ 7.8 x 300 mm, flow rate 2.0 mL/min, MeCN:H₂O, 1:9 (0 min)→2:8 (30 min)) to afford phlorigidoside C (2, 1.2 mg) in 34% yield. The EtOAc layer was purified by reversed-phase HPLC (TSK-gel ODS-80Ts, TOSOH, φ 7.8 x 300 mm, flow rate 2.0 mL/min, MeCN:H₂O, 1:9 (0 min)→5:5 (30 min)) to afford (6Z)-foliamentic acid methyl ester (3, 0.8 mg) in 46% yield.

**Sesinoside (1)**

Amorphous powder. [α]D: -65.6 (c 1.00, CH₂OH).
IR (KBr): 3398, 1705, 1635 cm⁻¹.
UV (MeOH): mm (log ε): 230 (4.10).
¹H (500 MHz) and ¹³C NMR (125 MHz): Table 1.
ESI-MS (positive ion): m/z 593 [M + Na⁺].

**Phlorigidoside C (2)**

¹H (500 MHz) and ¹³C NMR (125 MHz): Table 1.
ESI-MS (positive ion): m/z 427 [M + Na⁺].

(6Z)-Foliamentic acid methyl ester (3)

¹H NMR (500 MHz, CD₂OD): δH 6.79 (1H, t, J = 7.4 and 1.5 Hz, H-3), 5.45, (1H, t, J = 6.5 Hz, H-7), 4.10, (2H, dd, J = 6.5 and 1.0 Hz, H-8), 3.76, (3H, s, OMe), 2.37, (2H, td, J = 7.5 and 7.4 Hz, H-4), 2.26, (2H, t, J = 7.5 Hz, H-5), 1.87, (3H, br s, H-9), 1.80(3H, s, H-10) ESI-MS (positive ion): m/z 221 [M + Na⁺].
HRESI-MS: m/z 221.1156 [M + Na⁺] calcd for C₁₇H₂₃O₁₁Na: 221.1154.

**Acknowledgments**

This study was partially supported by a Grant-in-Aid for Scientific Research on Innovative Areas ‘Chemical Biology of Natural Products’ (Grant No. 24102509) from the Ministry of Education, Culture, Sports, Science and Technology, Japan.

**References**