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# A New 8',9'-Dinor 8,4'-Oxyneolignan Glucoside from *Dendrobium* Aurantiacum var. Denneanum

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**Abstract:** An investigation of *n*-BuOH extract of *Dendrobium aurantiacum* var. *denneanum* stems has led to the isolation of a new 8',9'-dinor 8,4'-oxyneolignane glucoside, (-)-(7S,8S)-4-hydroxy-3,3',5,5'-tetramethoxy-8',9'-dinor-8,4'-oxyneoligna-7,9-diol-7'-al 4-O- $\beta$ -D-glucopyranoside (1), and four phenylpropanoid glycosides (2–5). The structures of the isolated compounds were elucidated by chemical and spectroscopic methods. This is the first report of norlignane from the genus *Dendrobium*.

**Keywords:** *Dendrobium aurantiacum* var. *denneanum*; norlignane; oxyneolignan glucoside; phenylpropanoid glycoside. © 2015 ACG Publications. All rights reserved.

## **1. Plant Source**

*Dendrobium*, a well-known genus of Orchidaceae family, is composed of more than 1100 species and widely distributed throughout Asia, Europe, and Australia [1]. *Dendrobium aurantiacum* Rchb. f. var. *denneanum* (Kerr.) Z. H. Tsi is used as "shihu" or "huangcao" in traditional or folk Chinese medicine for its antipyretic, eye-benefiting and immunomodulatory effects [2]. The stems of this plant were collected from the culture field in Shuangliu, Sichuan Province, China in April 2011. Prof. Dr. Min Li identified the species and the voucher specimen (SSF-20110410) was deposited at the School of Pharmacy, Chengdu University of TCM, Chengdu, China.

### 2. Previous Studies

So far, a lot of bibenzyls, phenanthrenes, fluorenones, phenylpropanoids, flavones, coumarins, lignans, and esters of aromatic acids have been isolated from the plant and other species of *Dendrobium* [3–8]. However, there is no reports of norlignans in genus *Dendrobium*. This paper

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describes the isolation and structural elucidation of one 8',9'-dinor 8,4'-oxyneolignan glucoside (1) and four phenylpropanoid glycosides (2–5).

#### **3. Present Study**

Air-dried stems of *D. aurantiacum* var. *denneanum* (10 kg) were extracted with 95% EtOH under reflux. The crude extracts were evaporated under reduced pressure to yield a dark brown residue (530 g), which was suspended in H<sub>2</sub>O and then successively partitioned with EtOAc and *n*-BuOH. The *n*-BuOH extract (110 g) was chromatographed over a D-101 macroporous adsorbent resin column. The portion eluted by 30% EtOH (48 g) was chromatographed over silica gel and Sephadex LH-20, and purified by RP semipreparative HPLC to afford a new 8',9'-dinor 8,4'-oxyneolignane glucoside, (–)-(7*S*,8*S*)-4-hydroxy-3,3',5,5'-tetramethoxy-8',9'-dinor-8,4'-oxyneoligna-7,9-diol-7'-al 4-O- $\beta$ -D-glucopyranoside (1), along with four known phenylpropanoid glycosides, 2'-O- $\beta$ -D-glucosylrosine (2) [9], *cis*-melilotoside (3) [10], *trans*-melilotoside (4) [11], and methyl *O*-coumarate- $\beta$ -D-glucoside (5) [12]. Their structures (Figure 1) were established by MS and NMR spectral analysis and comparison with literature data.

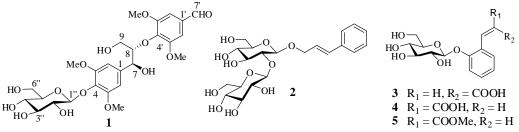


Figure 1. Structures of compounds 1–5.

(-)-(75,8S)-4-Hydroxy-3,3',5,5'-tetramethoxy-8',9'-dinor-8,4'-oxyneoligna-7,9-diol-7'-al 4-O-β-Dglucopyranoside (1): colorless gum;  $[\alpha]_D^{20} = -31.2$  (c = 0.04, MeOH); IR  $v_{max}$  (KBr): 3359, 2923, 2853, 1596, 1503, 1461, 1422, 1332, 1123, 1057, 875, 799, 713 cm<sup>-1</sup>; <sup>1</sup>H and <sup>13</sup>C NMR: see Table 1; HRESIMS: m/z 593.1854 [M+Na]<sup>+</sup> (calcd. for C<sub>26</sub>H<sub>34</sub>O<sub>14</sub>Na, 593.1846).

Compound 1 was obtained as a colorless gum. The molecular formula was determined as  $C_{26}H_{34}O_{14}$  by HRESIMS at m/z 593.1854 [M+Na]<sup>+</sup>, and the presence of OH (3359 cm<sup>-1</sup>) and aromatic (1596 and 1503 cm<sup>-1</sup>) groups were indicated by its IR spectrum. The <sup>1</sup>H NMR spectrum of **1** (Table 1) displayed resonances attributable to two symmetrically 1,3,4,5-tetrasubstituted aromatic rings [ $\delta_{\rm H}$ 7.22 (2H, s, H-2', 6') and 6.79 (2H, s, H-2, 6)], two oxymethines [ $\delta_{\rm H}$  5.02 (d, J = 5.4 Hz, H-7) and 4.49 (m, H-8)], an oxymethylene group [ $\delta_{\rm H}$ 3.84 (m, H-9a) and 3.54 (dd, J = 12.0, 4.8 Hz, H-9b)], an aldehyde group  $[\delta_{\rm H}9.83 \text{ (s, H-7')}]$ , and four aromatic methoxy groups  $[\delta_{\rm H}3.82 \text{ (6H, s, OMe-3, 5)}]$  and 3.89 (6H, s, OMe-3, 5)s, OMe-3', 5')], suggesting an 8',9'-dinor-8,4'-oxyneoligna-7,9-diol-7'-al moiety in 1 [13-14]. In addition, a doublet assignable to an anomeric proton at  $\delta_{\rm H}$  4.77 (J = 7.2 Hz), together with the partially overlapped signals attributed to oxymethylene and oxymethine protons between  $\delta_{\rm H}$  3.15 and 3.80, indicated that there was a  $\beta$ -glycosyl unit in **1**. The <sup>13</sup>C NMR and DEPT spectra of **1** revealed carbon signals (Table 1) corresponding to the above protonated units and eight aromatic quaternary carbons  $[\delta_{C} 133.7 (C-1'), 135.7 (C-4), 139.3 (C-1), 143.5 (C-4'), 153.8 (C-3, 5), and 154.7 (C-3', 5')]$ . On the basis of the above spectroscopic data analysis, the planar structure of 1 was established as 4-hydroxy-3,3',5,5'-tetramethoxy-8',9'-dinor-8,4'-oxyneoligna-7,9-diol-7'-al 4-O- $\beta$ -glucopyranoside, which was confirmed by the 2D NMR experiment. In particular, the HMBC correlations of H-1" with C-4 and of H-7' with C-1' and C-2'/6' indicated the glycosyl unit and aldehyde group was located at C-4 and C-1'. respectively.

The relative configuration for the arylglycerol moiety in **1** was determined as *threo* on the basis of the chemical shift values of C-7 and C-8 ( $\delta$  73.9 and 87.7) [15–16]. Furthermore, enzymatic hydrolysis of **1** produced **1a** and a sugar. The sugar was further identified as D-glucose by the positive

optical rotation  $[\alpha]_D^{20}$  +46.0° [17] and TLC comparison with the authentic sugar sample. In the CD spectra of **1a**, a positive Cotton effect at 244 nm ( $\Delta \varepsilon$  +0.38) suggested 8S configuration for **1** [18]. Therefore, compound **1** was determined to be (–)-(7*S*,8*S*)-4-hydroxy-3,3',5,5'-tetramethoxy-8',9'-dinor-8,4'-oxyneoligna-7,9-diol-7'-al 4-O- $\beta$ -D-glucopyranoside.

Position	$\delta_{ m C}$	$\delta_{\rm H}$ (mult., J in Hz)	HMBC (H→C)
1	139.3	_	_
2	105.6	6.79 (s)	C-1, C-3, C-4, C-6, C-7
3	153.8	_	_
4	135.7	_	_
5	153.8	_	_
6	105.6	6.79 (s)	C-1, C-2, C-4, C-5, C-7
7	73.9	5.02 (d, J = 5.4 Hz)	C-1, C-2, C-6, C-8, C-9
8	87.7	4.49 (m)	C-1, C-7, C-4'
9a	62.2	3.84 (m)	C-7, C-8
9b		3.54 (dd, <i>J</i> = 12.0, 4.8 Hz)	
1'	133.7	_	_
2'	107.9	7.22 (s)	C-1', C-3', C-4', C-6', C-7'
3'	154.7	_	_
4'	143.5	_	_
5'	154.7	_	_
6'	107.9	7.22 (s)	C-1', C-2', C-4', C-5', C-7'
7'	193.0	9.83 (s)	C-1', C-2', C-6'
1″	105.6	4.77 (d, <i>J</i> = 7.2 Hz)	C-4, C-3″
2″	75.8	3.46 (m)	C-1", C-4"
3″	77.7	3.41 (m)	C-1", C-2", C-4", C-5"
4″	71.3	3.40 (m)	C-2", C-3", C-6"
5″	78.4	3.20 (m)	C-3", C-4"
6″a	62.6	3.78 (dd, <i>J</i> = 12.6, 2.4 Hz)	C-4"
6″b		3.67 (dd, <i>J</i> = 12.6, 6.0 Hz)	
3/5-OMe	56.9	3.82 (s)	C-3/5
3'/5'-OMe	56.8	3.89 (s)	C-3'/5'

**Table 1.** <sup>1</sup>H (600 MHz) and <sup>13</sup>C NMR (150 MHz) data for compound **1** in CD<sub>3</sub>OD ( $\delta$  in ppm, J in Hz).

## **Supporting Information**

Supporting Information accompanies this paper on http://www.acgpubs.org/RNP

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