Lignans from *Wikstroemia hainanensis*

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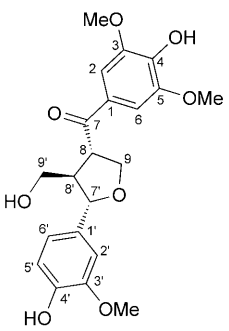
The structures and conformations of three new lignans, wikstrone (**1**), wikstroemol (**2**), and wikstroemone (**3**) – isolated from the aerial parts of *Wikstroemia hainanensis* – were determined, together with those of twelve known compounds, including *erythro*-guaiacylglycerol-β-*O*-4′-sinapyl ether (**4**). The configuration of **4**, falsely assigned in the literature (*threo* configuration), was redetermined, and the compound was identified as *erythro*-guaiacylglycerol-β-*O*-4′-sinapyl ether.

Introduction. – The genus *Wikstroemia* belongs to the family Thymelaeaceae. Several species of this genus were shown to produce biologically active daphnane- [1] and tigliane-type [2] diterpenoids, lignans [3], biflavonoids [3b] [4], and bicoumarins [3]. *Wikstroemia hainanensis* MERR., a tiny shrub indigenous to Hainan Province, China, has not been chemically investigated previously. In the current paper, three new lignans, wikstrone (**1**), wikstroemol (**2**), and wikstroemone (**3**), along with twelve known compounds, *erythro*-guaiacylglycerol-β-*O*-4′-sinapyl ether (**4**), 4-hydroxy-*trans*-cinnamic acid, (+)-pinoresinol, (+)-medioresinol, (+)-syringaresinol, (+)-nortrachelogenin, (−)-lariciresinol, ficusesquilignan A, sitosterol, hederagenin, umbelliferone, and daphnoretin, were isolated from the aerial parts of *W. hainanensis*, and structurally identified by spectroscopic methods.



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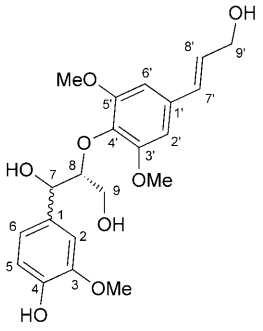
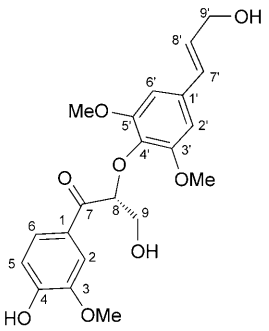


2 (7*R*,8*R*): *threo*
4 (7*S*,8*R*): *erythro*



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Results and Discussion. – The crude EtOH extract of the aerial parts of *W. hainanensis* was suspended in H_2O and extracted with AcOEt and BuOH. Extensive purification by column and preparative thin-layer chromatography of the AcOEt-soluble fraction afforded **1**–**3** and the above twelve known compounds.

Wikstrone (**1**) was obtained as a colorless amorphous powder. The M^+ signal in the HR-EI mass spectrum was observed at *m*/*z* 404.1456, consistent with a molecular formula of $C_{21}H_{24}O_8$. The IR spectrum showed absorptions for OH (3419), conjugated C=O (1662), and aromatic (1605, 1518, 1462 cm^{-1}) groups. The UV maxima at 230, 285, and 308 nm were indicative of the presence of a lignan skeleton based on a tetrahydrofuranoketone [5]. The presence of a conjugated ketone C=O moiety was further supported by the ^{13}C-NMR resonance at δ(C) 198.4. Further analysis of 1D- and 2D-NMR (*Table 1*) and circular dichroism (CD) data enabled us to elucidate the structure of **1** as (4-hydroxy-3,5-dimethoxyphenyl)[(3*S*,4*R*,5*S*)-tetrahydro-5-(4-hydroxy-3-methoxyphenyl)-4-(hydroxymethyl)furan-3-yl]methanone.

In the ^{1}H-NMR spectrum of **1** (*Table 1*), a 4-substituted 3,5-dimethoxybenzoyl group (δ(H) 7.41 (*s*, 2 H); 3.90 (*s*, 6 H)) and a 1,3,4-trisubstituted benzene (δ(H) 7.04 (*d*, *J* = 1.2 Hz, 1 H); 6.85 (*dd*, *J* = 8.1, 1.2

Table 1. *NMR Data of Compounds* **1** *and* **3**. At 400 MHz (^{1}H, HMBC) or 100 MHz (^{13}C) in $(CD_3)_2CO$ (**1**) and $CDCl_3$ (**3**) solution; δ in ppm, *J* in Hz.

Position	**1**			**3**		
	δ(H)	δ(C)	HMBC (H → C)	δ(H)	δ(C)	HMBC (H → C)
H–C(1)	–	128.2	–	–	128.3	–
H–C(2)	7.41 (*s*)	107.0	1, 3, 4, 6, 7	7.67 (*d*, *J* = 1.9)	113.9	1, 3, 5, 6, 7
H–C(3)	–	148.2	–	–	146.7	–
H–C(4)	–	141.7	–	–	150.6	–
H–C(5)	–	148.2	–	6.96 (*d*, *J* = 8.2)	110.7	1, 3, 4
H–C(6)	7.41 (*s*)	107.0	1, 2, 4, 5, 7	7.64 (*dd*, *J* = 8.2, 1.9)	124.0	4, 5, 7
H–C(7)	–	198.4	–	–	194.7	–
H–C(8)	4.13 (*m*)	49.3	7, 7′, 8′	5.15 (*dd*, *J* = 7.4, 2.9)	87.3	1′, 7, 9
H_α–C(9)	4.18 (*m*)	70.7	7, 8, 7′, 8′	3.95 (*dd*, *J* = 12.0, 7.4)	63.6	8
H_β–C(9)	4.32 (*dd*, *J* = 13.6, 6.9)		7, 7′, 8′	3.85 (*dd*, *J* = 12.0, 2.9)		8
H–C(1′)	–	133.7	–	–	133.1	–
H–C(2′)	7.04 (*d*, *J* = 1.2)	110.8	1′, 3′, 6′, 7′	6.61 (*s*)	103.5	1′, 3′, 4′, 6′, 7′
H–C(3′)	–	148.0	–	–	152.5	–
H–C(4′)	–	146.6	–	–	136.3	–
H–C(5′)	6.77 (*d*, *J* = 8.1)	115.0	1′, 2′, 3′, 4′	–	152.5	–
H–C(6′)	6.85 (*dd*, *J* = 8.1, 1.2)	120.0	1′, 2′, 4′, 7′	6.61 (*s*)	103.5	1′, 2′, 3′, 4′, 7′
H–C(7′)	4.66 (*d*, *J* = 8.5)	83.9	1′, 2′, 6′, 8′, 9′	6.55 (br. *d*, *J* = 15.8)	130.7	6′, 9′
H–C(8′)	2.61 (*m*)	54.2	7, 8, 1′, 7′	6.30 (*dt*, *J* = 15.8, 5.7)	128.6	1′, 9′
H_a–C(9′)	3.67 (*dd*, *J* = 11.3, 4.4)	60.2	8, 8′, 9′	4.35 (*dd*, *J* = 5.7, 1.4)	63.5	7′, 8′
H_b–C(9′)	3.63 (*dd*, *J* = 11.3, 4.9)		8, 8′, 9′	4.35 (*dd*, *J* = 5.7, 1.4)		
3-MeO	3.90 (*s*)	56.4	3	3.95 (*s*)	56.1	3
4-MeO	–	–	–	6.19 (br. *s*)	–	–
5-MeO	3.90 (*s*)	56.4	5	–	–	–
3′-MeO	3.83 (*s*)	55.9	3′	3.75 (*s*)	55.9	3′
5′-MeO	–	–	–	3.75 (*s*)	55.9	5′

Hz, 2 H); 6.77 (*d*, *J* = 8.1 Hz, 1 H)) were distinguished. An aromatic MeO group (δ(H) 3.83 (s, 3 H)), a diastereoisotopic, oxygenated CH_2 group (δ(H) 3.67 (*dd*, *J* = 11.3, 4.4 Hz, 1 H); 3.63 (*dd*, *J* = 11.3, 4.9 Hz, 1 H)), as well as a tetrahydrofuran ring (δ(H) 4.66 (*d*, *J* = 8.5 Hz, 1 H); 4.32 (*dd*, *J* = 13.6, 6.9 Hz, 1 H); 4.18 (*m*, 1 H); 4.13 (*m*, 1 H); 2.61(*m*, 1 H)) [5] were identified. The ^{13}C-NMR signal at δ(C) 60.2 was assigned to C(9′)[1]. These observations suggested that **1** had a tetrahydrofuranoketone lignan skeleton similar to that of sesaminone [5b], (+) episesaminone [5c], and magnones A and B [5d]. A total of 16 carbon signals, including one C=O, ten aromatic carbons (four CH and six C_q), two MeO, two oxygenated CH_2, and three CH (one oxygenated) were resolved in the ^{13}C-NMR (DEPT) spectrum (*Table 1*). EI-MS fragment ions at *m*/*z* 181 and 137 (*Fig. 1*), resulting from benzoyl and benzyl cleavages, further confirmed our structural assignments.

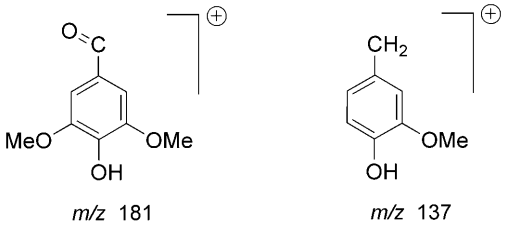

Fig. 1. *Characteristic mass fragments of* **1**

The structure of **1** and the complete assignment of its ^{1}H- and ^{13}C-NMR data were finally accomplished *via* an HMBC experiment (*Table 1* and *Fig. 2*). In particular, the key correlation between the resonance at δ(H) 3.83 (MeO) and C(3′) revealed a 3′-MeO group, the correlations of CH_2(9) with C(7′), C(8′), and C(8) established the tetrahydrofuran ring, and the correlations of CH_2(9′) with C(7′), C(8′), and C(8) showed that the CH_2OH group was located at C(8′). Analogously, correlations of H–C(2), H–C(8), H–C(8′), and CH_2(9) with C(7) indicated that the 4-hydroxy-3,5-dimethoxybenzoyl group was at C(8), and those of H–C(2′) and H–C(6′) with C(7′) revealed that the 4-hydroxy-3-methoxyphenyl group was linked to C(7′).

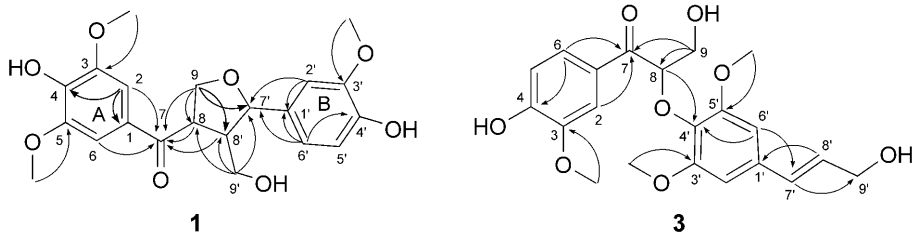

Fig. 2. *Selected HMBC* (H → C) *correlations for compounds* **1** *and* **3**

The relative configuration of **1** was determined by analysis of ^{1}H-NMR data and NOESY correlations (*Fig. 3*, *a*). The chemical shift of H–C(7′) at *ca.* δ(H) 4.7 suggested that H–C(7′) and H–C(8′) were *trans*-oriented[2]), and this was supported by a NOESY correlation between H–C(2′) and H–C(8′). Based on NOE correlations of H–C(8)/H–C(7′) and H–C(2)/H–C(6′), we placed H–C(8) and H–C(7′) on the same side of the tetrahydrofuran ring (*trans*-orientation of H–C(8) and H–C(8′)).

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[1]) Arbitrary atom numbering.

[2]) For a *cis*-form, δ(H) was reported to be *ca.* 5.5 [5d].

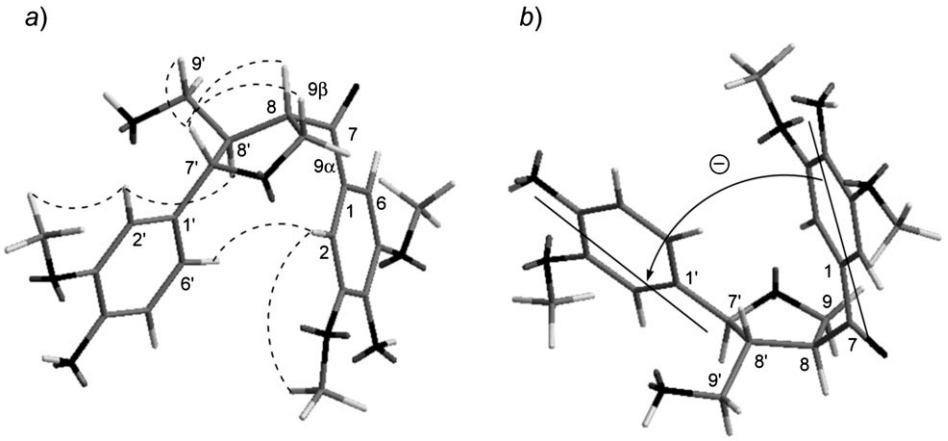


Fig. 3. a) *Key NOESY correlations for compound* **1**. b) *Exciton coupling in* **1**

The absolute configuration of **1** was established by analysis of its CD spectrum. A negative first *Cotton* effect caused by the exciton coupling of the benzoyl and benzene chromphores (*Fig. 3,b*) suggested that the compound had the (8*S*,7′*S*)-configuration.

Wikstroemol (**2**) was isolated as a colorless, amorphous powder. ESI Mass spectroscopy showed signals at *m/z* 445.1 ($[M+K]^+$) and 429.3 ($[M+Na]^+$), which, in combination with the ^{1}H- and ^{13}C-NMR data (*Table 2*), suggested a molecular formula of $C_{21}H_{24}O_8$. The IR absorptions of **2** were indicative of the presence of OH (3427), C=C (1659), and benzene (1583, 1504, 1456 cm^{-1}) groups. The ^{1}H- and ^{13}C-NMR data of **2** showed high similarity with those of the known compound **4** isolated from *Brassica fruticulosa* [6], suggesting that they possibly had the same constitution. An HMBC experiment was, thus, carried out, and the proposed structure of **2** was confirmed. Conformational analysis (*Fig. 4*) [7] revealed that the coupling constant of 7.3 Hz between H–C(7) and H–C(8) was in accord with an *anti*- or *threo*-configuration. Furthermore, a negative *Cotton* effect at 234 nm indicated that the absolute configuration of **2** was (7*R*,8*R*) [8]. From these data, the structure of **2** was, therefore, established as *threo*-(1*R*,2*R*)-guaiacylglycerol-*β*-*O*-4′-sinapyl ether, which corresponds to (1*R*,2*R*)-1-(4-hydroxy-3-methoxyphenyl)-2-({4-[(*E*)-3-hydroxyprop-1-enyl]-2,6-dimethoxyphenyl}-oxy)propane-1,3-diol.

The above assignment was in conflict with a report of *Cutillo et al*. [6], who had assigned the *threo*-configuration to compound **4** isolated from *Brassica fruticulosa*. Since we had isolated both **2** and **4** from the current plant, we analyzed the ^{1}H-NMR data (*Table 2*) of **4** and its optical rotation ($[\alpha]_D^{21} = +8.5$ ($c = 0.13$, MeOH)). Our experiments unequivocally corroborated that the data of **4** isolated by us were fully identical with those reported for putative **2** [6]. The coupling constant $J(7,8)$ was 5.0 (in CD_3OD) or 3.7 Hz (in $CDCl_3$) for **4**, which is indicative of a *syn*- or *erythro*-configuration (*Fig. 4*). The absolute (7*S*,8*R*) configuration was assigned on the basis of a negative *Cotton* effect at 234 nm [6]. Compound **4**, thus, corresponds to *erythro*-(1*S*,2*R*)-guaiacylglycerol-*β*-*O*-4′-sinapyl ether. From comparison of ^{13}C-NMR data (*Table 2*), **4** had been isolated before [9], but not elucidated from a stereochemical point of view.

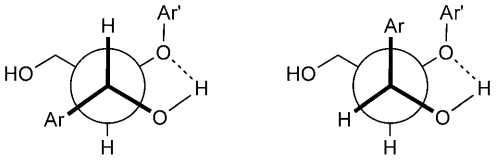
Table 2. *NMR Data of Compounds* **2** *and* **4**. δ in ppm, J in Hz.

Position	**2**			**4**			
	δ(H)[a]	δ(C)[b]	δ(H)[c]	δ(H)[a]	δ(C)[d]	δ(H)[c]	δ(C)[e]
H–C(1)	–	133.9	–	–	134.1	–	133.3
H–C(2)	7.01 (*d*, *J* = 1.9)	112.3	6.97 (*d*, *J* = 1.9)	6.98 (*d*, *J* = 1.9)	111.7	6.95 (*d*, *J* = 1.8)	110.9
H–C(3)	–	147.7	–	–	147.2	–	147.0
H–C(4)	–	149.3	–	–	148.9	–	145.3
H–C(5)	6.75 (*d*, *J* = 8.2)	116.4	6.87 (*d*, *J* = 7.9)	6.75 (*d*, *J* = 8.1)	116.0	6.84 (*d*, *J* = 8.0)	114.7
H–C(6)	6.87 (*dd*, *J* = 8.2, 1.9)	121.5	6.96 (*dd*, *J* = 7.9, 1.9)	6.79 (*dd*, *J* = 8.1, 1.9)	120.9	6.74 (*dd*, *J* = 8.0, 1.8)	119.2
H–C(7)	4.98 (*d*, *J* = 7.3)	75.1	5.03 (*d*, *J* = 8.9)	4.92 (*d*, *J* = 5.0)	74.3	5.00 (*d*, *J* = 3.7)	72.0
H–C(8)	4.02 (*ddd*, *J* = 7.3, 3.8, 3.0)	89.7	3.89 (*m*)	4.21 (*m*)	87.9	4.14 (*ddd*, *J* = 6.8, 3.7, 2.8)	86.2
H_a–C(9)	3.75 (*dd*, *J* = 12.1, 3.8)	62.2	3.58 (*dd*, *J* = 11.6, 2.5)	3.89 (*dd*, *J* = 11.9, 5.6)	61.7	3.91 (*dd*, *J* = 12.1, 6.8)	59.7
H_b–C(9)	3.29 (*dd*, *J* = 12.1, 3.0)		3.34 (*dd*, *J* = 11.6, 3.8)	3.55 (*dd*, *J* = 11.9, 3.5)		3.51 (*dd*, *J* = 12.1, 2.8)	
H–C(1′)	–	135.4	–	–	135.1	–	132.3
H–C(2′)	6.75 (*s*)	105.3	6.65 (*s*)	6.72 (*s*)	105.2	6.64 (*s*)	103.7
H–C(3′)	–	154.8	–	–	154.9	–	152.8
H–C(4′)	–	137.4	–	–	136.7	–	134.9
H–C(5′)	–	154.8	–	–	154.9	–	152.8
H–C(6′)	6.75 (*s*)	105.3	6.65 (*s*)	6.72 (*s*)	105.2	6.64 (*s*)	103.8
H–C(7′)	6.54 (br. *d*, *J* = 15.8)	131.8	6.54 (br. *d*, *J* = 15.8)	6.54 (br. *d*, *J* = 15.8)	131.7	6.55 (*dt*, *J* = 15.8, 1.3)	130.1
H–C(8′)	6.32 (*dt*, *J* = 15.8, 5.6)	130.5	6.31 (*dt*, *J* = 15.8, 5.6)	6.31 (*dt*, *J* = 15.8, 5.8)	130.1	6.31 (*dt*, *J* = 15.8, 5.7)	128.5
H_a–C(9′)	4.21 (*dd*, *J* = 5.6, 1.5)	64.1	4.33 (*dd*, *J* = 5.6, 1.3)	4.22 (*dd*, *J* = 5.8, 1.3)	63.8	4.32 (*dd*, *J* = 5.7, 1.3)	61.5
H_b–C(9′)	4.21 (*dd*, *J* = 5.6, 1.5)		4.33 (*dd*, *J* = 5.6, 1.3)	4.22 (*dd*, *J* = 5.8, 1.3)		4.32 (*dd*, *J* = 5.7, 1.3)	
3-MeO	3.82 (*s*)	56.8	3.88 (*s*)	3.83 (*s*)	56.6	3.86 (*s*)	55.5
4-OH	–	–	5.77 (br. *s*)	–	–	–	–
3′-MeO	3.86 (*s*)	57.1	3.91 (*s*)	3.83 (*s*)	56.6	3.86 (*s*)	56.0
5′-MeO	3.86 (*s*)	57.1	3.91 (*s*)	3.83 (*s*)	56.6	3.86 (*s*)	56.0

[a]) At 400 MHz in CD_3OD. [b]) At 100 MHz in CD_3OD. [c]) At 400 MHz in $CDCl_3$. [d]) At 125 MHz in CD_3OD. [e]) At 100 MHz in (D_6)DMSO

Wikstroemone (**3**) had the molecular formula $C_{21}H_{24}O_8$ as determined by the HR-ESI-MS (*m*/*z* 427.1385 ($C_{21}H_{24}O_8Na^+$, calc. 427.1369)). Its IR spectrum showed absorptions for OH (3439), C=O (1672), and benzene (1587, 1506, 1464 cm^{-1}) groups. The ^{1}H- and ^{13}C-NMR data indicated that compound **3** was likely a C(7) ketone derivative of **4**, and the HMBC spectrum further secured the proposed structure.

The ^{1}H-NMR data of **3** and **4** (both in $CDCl_3$) showed the absence of a *doublet* at *ca.* δ(H) 5.0 for H–C(7), downfield shifted ^{1}H-NMR signals (δ(H) 7.67 (*d*, *J* = 1.9 Hz, H–C(2)); 6.96 (*d*, *J* = 8.2, H–C(5)); 7.64 (*dd*, *J* = 8.2, 1.9 Hz, H–C(6)), and a significant coupling pattern and chemical-shift change of H–C(8) (δ(H) 5.15 (*dd*, *J* = 7.4, 2.9 Hz)). The latter two differences were likely caused by the presence of



2 *threo (anti)* **4** *erythro* (*syn*)

Fig. 4. Newman *projections along the C(7)–C(8) bonds of compounds* **2** *and* **4**. Dashed lines represent H-bonds.

the 7-keto group. A ^{13}C-NMR signal at δ(C) 194.7 (conjugated C=O) further supported the above assumption. The observed HMBC correlations further secured the proposed structure of **3**, as depicted in *Fig. 2*. In consideration of the co-occurrence of compounds **2**–**4** in the same plant, and for biogenetic reasons, either of the two compounds **2** and **4** was supposed to be a biosynthetic precursor of **3**, and the absolute configuration of **3** was, thus, assumed to be (8*R*). From these data, wikstroemone (**3**) was designated as (2*R*)-3-hydroxy-1-(4-hydroxy-3-methoxyphenyl)-2-({4-[(*E*)-3-hydroxyprop-1-enyl]-2,6-dimethoxyphenyl}oxy)propan-1-one.

Among the twelve known compounds, 4-hydroxy-*trans*-cinnamic acid [10], sitosterol [11], daphnoretin [12], and umbelliferone [13] were identified from their ^{1}H-NMR data and by comparison with authentic samples (co-TLC); (+)-pinoresinol [14], (+)-medioresinol [15], (+)-syringaresinol [16], (+)-nortrachelogenin [17], (−)-lariciresinol [18], ficusesquilignan A [19], and hederagenin [20] were identified by comparison of their optical-rotation and ^{1}H- and ^{13}C-NMR data.

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Experimental Part

General. All solvents were of anal. grade (*Shanghai Chemical Plant*, Shanghai). Column chromatography (CC): silica gel (200–300 mesh), silica gel *H60*, *C18* reverse-phase (RP) silica gel (250 mesh; *Merck*), and *MCI* gel (*CHP20P*, 75–150 μm; *Mitsubishi Chemical Industries, Ltd.*). TLC: pre-coated silica gel *GF254* plates (*Qingdao Haiyang Chemical Plant,* Qingdao). UV Spectra: *Hitachi U-2010*; λ_{max} (log ε) in nm. Optical rotation: *Perkin-Elmer 341* polarimeter. CD Spectra: *JASCO J-810* instrument; $\Delta\varepsilon$ (λ_{max}). IR Spectra: *Perkin-Elmer 577* spectrometer. NMR Spectra: *Bruker AM-400* spectrometer; Me_4Si as internal standard; δ in ppm, *J* in Hz. EI-MS (70 eV): *Finnigan MAT 95* mass spectrometer; in *m*/*z* (rel. %).

Plant Material. The leaves and stems of *Wikstroemia hainanensis* MERR. were collected in September 2004 in Hainan province, P. R. China. The plant was authenticated by Prof. *Shi-Man Huang*, Department of Biology, Hainan University. A voucher specimen was deposited at the Shanghai Institute of Materia Medica (accession number WH-2004–1Y).

Extraction and Isolation. The powdered leaves and stems of *W. hainanensis* (7.5 kg) were percolated with 95% EtOH. After removal of the solvent under reduced pressure, a greenish extract (280 g) was obtained, which was suspended in H_2O (1000 ml), and extracted successively with AcOEt and BuOH. The AcOEt-soluble fraction (70 g) was fractionated by CC (SiO_2; petroleum ether/Me_2CO 20:1 → 0:1): *Fr. 1* and *Fr. 2*. *Fr. 1* (1.5 g) was separated by CC (SiO_2; petroleum ether/AcOEt 10:1 → 2:1) to

give a major fraction, recrystallization of which from $CHCl_3$/MeOH 10:1 afforded β-sitosterol (55 mg). *Fr. 2* (15 g) was subjected to CC (*MCI*-gel, MeOH/H_2O 4:6 → 9:1): *Fr. 2a* and *2b*. *Fr. 2a* (5.1 g) was further chromatographed (SiO_2; petroleum ether/ AcOEt 2.5:1 → 1:3): *Fr. 2a.1–2a.7*. *Fr. 2a.1* (92 mg) was separated by CC (SiO_2; $CHCl_3$/MeOH 200:1) to yield umbelliferone (4 mg) and 4-hydroxy-*trans*-cinnamic acid (5 mg). *Fr. 2a.2* (54 mg) was purified by CC (SiO_2; $CHCl_3$/MeOH 200:1) to afford (+)-pinoresinol (28 mg) and (+)-nortrachelogenin (16 mg). Purification of *Fr. 2a.3* (20 mg) by prep. TLC ($CHCl_3$/MeOH 80:1) yielded (+)-medioresinol (15 mg). Purification of *Fr. 2a.4* (927 mg) by CC (SiO_2; $CHCl_3$/MeOH 200:1 → 50:1) gave (+)-syringaresinol (33 mg) and (−)-lariciresinol (133 mg). *Fr. 2a.5* (858 mg) was first fractionated to give two fractions, *Fr. 2a.5.1* and *2a.5.2*. *Fr. 2a.5.1* (82 mg) was further purified by CC (*RP-18*; MeOH/H_2O 40:60) to afford ficusesquilignan A (23 mg), and purification of *Fr. 2a.5.2* (141 mg) by CC (RP-18; MeOH/H_2O 35:65) gave **2** (16 mg) and **4** (60 mg). *Fr. 2a.6* (121 mg) was purified by CC (SiO_2; $CHCl_3$/MeOH 30:1) to afford **3** (5 mg). *Fr. 2a.7* (87 mg) was separated first on a *Sephadex LH-20* column (MeOH), and then by CC (*RP-18*; MeOH/H_2O 40:60) to afford **1** (6 mg). *Fr. 2b* (0.85 g) was fractionated by CC (SiO_2, petroleum ether/AcOEt 2:1 → 1:2) to afford two fractions, which were further purified by CC (SiO_2; $CHCl_3$/MeOH 50:1) to provide hederagenin (12 mg) and daphnoretin (7 mg), resp.

Wikstrone (= *(4-Hydroxy-3,5-dimethoxyphenyl)[(3*S*,4*R*,5*S*)-tetrahydro-5-(4-hydroxy-3-methoxyphenyl)-4-(hydroxymethyl)furan-3-yl]methanone*; **1**). Colorless powder. UV (MeOH): 230 (4.22), 285 (3.95), 308 (3.96). $[\alpha]_D^{21} = -22$ ($c = 0.09$, $CHCl_3$). CD (MeOH): −1.9 (320), +0.51 (283). IR (KBr): 3419, 2939, 1662, 1605, 1518, 1462, 1423, 1323, 1278, 1217, 1165, 1117, 1036, 864, 754, 653. ^{1}H- and ^{13}C-NMR: see *Table 1*. EI-MS: 404 (26, M^+), 279 (9), 239 (8), 209 (14), 205 (16), 196 (36), 181 (62), 167 (30), 149 (100), 137 (14). HR-EI-MS: 404.1456 (M^+, $C_{21}H_{24}O_8^+$; calc. 404.1471).

Wikstroemol (= *(1*R*,2*R*)-1-(4-Hydroxy-3-methoxyphenyl)-2-({4-[(*E*)-3-hydroxyprop-1-enyl]-2,6-dimethoxyphenyl}oxy)propane-1,3-diol*; **2**). Colorless powder. UV (MeOH): 220 (4.30), 270 (3.99). $[\alpha]_D^{21} = -24$ ($c = 0.21$, $CHCl_3$). CD (MeOH): −0.86 (234). IR (KBr): 3427, 2918, 2848, 1659, 1583, 1504, 1456, 1421, 1335, 1242, 1155, 1124, 1013, 824, 1640. ^{1}H- and ^{13}C-NMR: see *Table 2*. ESI-MS: 445.1 (100, $C_{21}H_{26}KO_8^+$), 429.3 (62, $C_{21}H_{26}NaO_8^+$).

Wikstroemone (= *(2*R*)-3-Hydroxy-1-(4-hydroxy-3-methoxyphenyl)-2-({4-[(*E*)-3-hydroxyprop-1-enyl]-2,6-dimethoxyphenyl}oxy)propan-1-one*; **3**). Colorless powder. UV (MeOH): 205 (4.42), 223 (4.36), 272 (4.11), 306 (3.90). $[\alpha]_D^{21} = +5$ ($c = 0.20$, $CHCl_3$). IR (KBr): 3439, 2919, 2848, 1672, 1587, 1506, 1464, 1421, 1336, 1281, 1223, 1124, 1034, 633. ^{1}H- and ^{13}C-NMR: see *Table 1*. ESI-MS (pos.): 443.1 (42, $[M+K]^+$), 427.2 (100, $[M+Na]^+$). ESI-MS (neg.): 403.3 (100, $[M-H]^-$). HR-ESI-MS: 427.1385 ($[M+Na]^+$, $C_{21}H_{24}NaO_8^+$; calc. 427.1369).

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