Lignans and Their Degraded Derivatives from *Sarcostemma acidum*

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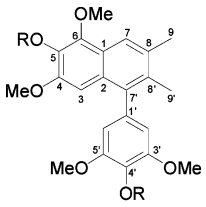
Four lignans, sacidumlignans A−D (**1**−**4**), and two degraded lignan derivatives, sacidumols A (**5**) and B (**6**), along with four known compounds, (+)-pinoresinol, 9α-hydroxypinoresinol, perforatic acid, and peucenine-7-*O*-methyl ether, were isolated from the ethanolic extract of the whole plant of *Sarcostemma acidum*. The structures and relative configuration of these new compounds were elucidated on the basis of spectroscopic and chemical data, especially 2D NMR techniques. Sacidumlignan D (**4**) was assigned as a rearranged tetrahydrofuran lignan with an unprecedented skeleton. Sacidumlignan A (**1**) showed moderate antimicrobial activities against two Gram-positive bacteria in vitro.

There are about 10 species in the genus *Sarcostemma*, distributed widely over the tropical and subtropical areas of Africa, America, and Asia.[1] Investigations on the plants of this genus started early in the last century aiming at the possible applications as natural resources for rubber and fuel.[2] Some of the plants in the genus *Sarcostemma* are toxic to the nervous system of livestock, and the chronically intoxicated animals will become paralyzed or die in one week.[3] Phytochemical analyses resulted in identifying a series of triterpene[4] and pregnane derivatives, and the pregnane derivatives were believed to be the toxic constituents.[5]

The plant *Sarcostemma acidum* (Roxb.), which grows in and over trees and shrubs near the seashore of Hainan Island of China, is a sturdy, succulent, and leafless creeper. It is the only species of this genus distributed in China and is applied in folklore medicine to remedy chronic cough and postnatal hypogalactia.[6] Investigation of *S. acidum* growing in India resulted in the isolation of malic acid, sugars, tannins, α-amyrin acetate, *β*-amyrin, leupeol, leupeol acetate, and *β*-sitosterol.[7] *S. acidum* growing in China has not been previously investigated chemically. In the current study, four new lignans, namely, sacidumlignans A−D (**1**−**4**), and two new degraded lignan derivatives, sacidumols A (**5**) and B (**6**), along with four known compounds, (+)-pinoresinol, 9α-hydroxypinoresinol, perforatic acid, and peucenin-7-*O*-methyl ether, were isolated from the ethanolic extract of the whole plant of *S. acidum* collected from Hainan Island of China. The structures and relative configuration of these new compounds were elucidated on the basis of spectroscopic and chemical data, especially 2D NMR techniques. We report herein the isolation and structural elucidation of these new compounds, one of which showed antimicrobial activities against two Gram-positive bacteria in vitro.



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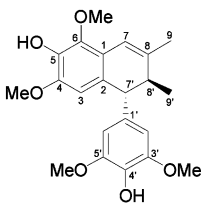

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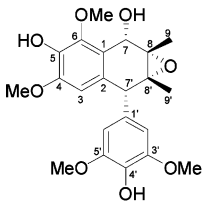

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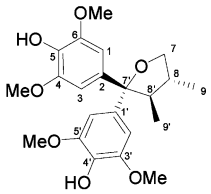

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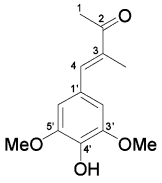

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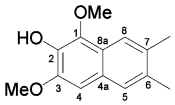

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Results and Discussion

Sacidumlignan A (**1**) was obtained as colorless needles from MeOH. Its molecular formula was determined as $C_{22}H_{24}O_6$ by HREIMS at *m/z* 384.1575 $[M]^+$ (calcd 384.1573). The IR spectrum showed the presence of hydroxyl (3425 cm^{-1}) and aromatic moieties (1611, 1495, and 1451 cm^{-1}). The UV maximum absorptions at 205, 239, 290, and 331 nm supported the presence of aromatic moieties. The ^1H NMR spectrum showed the presence of three aromatic proton singlets at *δ* 7.74 (1H, s), 6.56 (1H, s), and 6.47 (2H, s), three three-proton singlets at *δ* 3.95 (3H, s), 3.82 (6H, s), and 3.66 (3H, s) assignable to four *O*-methyl groups, and two three-proton singlets at *δ* 2.43 (3H, s) and 2.09 (3H, s) attributable to the methyl groups likely attached to the aromatic ring. The ^{13}C NMR and DEPT spectra of **1** showed the presence of six methyls (four *O*-methyls), four methines (two overlapping), and 12 quaternary carbons. The occurrence of 11 degrees of unsaturation as deduced from the molecular formula and the aforementioned spectroscopic data implied that **1** was a highly oxygenated lignan possessing an arylnaphthalene backbone. Complete methylation of **1** by CH_3I in the presence of anhydrous Na_2CO_3 in acetone gave **1a**. The HMBC experiment showed the linkages between C-8 and C-8′, between C-2 and C-7′, and between C-1′ and C-7′ as judged from the correlations between H-9 and C-8′ (or H-9′ and C-8), between H-3 and C-7′, and between H-2′ and C-7′ (or H-6′ and C-7′), respectively. The *O*-methyl groups at *δ* 3.95 (3H, s) and 3.66 (3H, s) were linked to C-6 and C-4, as determined by their correlations with C-6 and C-4, respectively (see Figure

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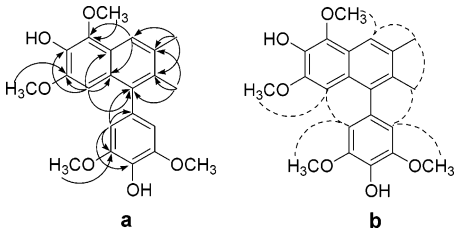

Figure 1. (a) Selected HMBC correlations (H→C); (b) key NOESY (- - -) correlations of sacidumlignan A (**1**).

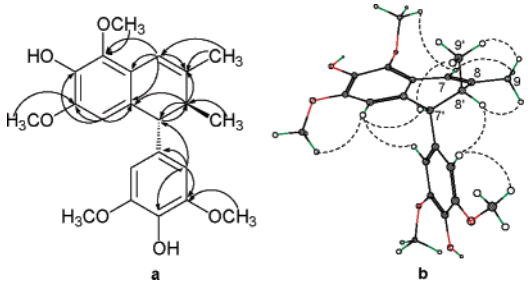

Figure 2. (a) Selected HMBC (H→C) correlations; (b) key NOESY (- - -) correlations and conformation (generated by computer modeling) of sacidumlignan B (**2**).

1a). The HMBC correlations also allowed the assignment of the two overlapping *O*-methyl groups at 3.82 (6H, s) linked to C-3′ and C-5′. The structural assignment of **1** was further confirmed by NOESY correlations (see Figure 1b). Therefore, the structure of **1** was elucidated as 5,4′-dihydroxy-4,6,3′,5′-tetramethoxy-2,7′-cycloligna-7,7′-diene and designated by the name sacidumlignan A.

Sacidumlignan B (**2**), a white amorphous powder, showed the molecular formula $C_{22}H_{26}O_6$ as determined by HREIMS at *m/z* 386.1733 $[M]^+$ ($C_{22}H_{26}O_6$, calcd 386.1729). The IR spectrum of **2** exhibited the presence of hydroxyls at 3493 cm^{-1} and aromatic rings at 1619 and 1495 cm^{-1}. Compound **2** showed two mass units more than **1**, and the UV absorptions pattern of compound **2** was also blue shifted, indicating that **2** was less aromatized than **1**. In the ^1H NMR spectrum of **2**, two aromatic proton singlets at δ 6.47 (1H, s) and 6.39 (2H, s), one doublet at δ 6.43 (1H, d, J = 1.2 Hz) coupled with a methyl at δ 1.80 (3H, d, J=1.2 Hz), and three coupled protons at δ 3.64 (1H, d, J = 3.0 Hz), 2.04 (1H, dq, J = 7.0, 3.0 Hz), and 1.02 (3H, d, J = 7.0 Hz) assignable to a structural fragment −CHCH(CH_3)− were observed; three three-proton singlets at δ 3.79 (3H, s), 3.68 (6H, s), and 3.72 (3H, s) attributable to the presence of four *O*-methyl groups were also present. The spectroscopic data indicated that compound **2** is a lignan with an aryldihydronaphthalene skeleton. An HMBC experiment confirmed both the basic skeleton and the locations of the *O*-methyl and hydroxyl groups (see Figure 2a).

The relative configuration at C-7′ and C-8′ was established by analysis of a NOESY experiment (see Figure 2b). The small coupling constant between H-7′ and H-8′ (J = 3.0 Hz) suggested that two protons adopted a gauche orientation and were most likely in a trans configuration.[8] This assignment was confirmed by the NOESY spectrum, in which the interaction between H-8′ and H-2′/H-6′ clearly indicated that H-8′ and the C-7′ phenyl group were co-facial and were arbitrarily defined as α-oriented. The NOESY correlation between H-7′ and H_3-9′ further supported the relative C-7′ and C-8′ configurations. Thus, the structure of sacidumlignan B was elucidated as *rel*-(7′α,8′β)-5,4′-dihydroxy-4,6,3′,5′-tetramethoxy-2,7′-cycloligna-7-ene.

The molecular formula of sacidumlignan C (**3**) was assigned as $C_{22}H_{26}O_8$ by HREIMS. Comparison of the ^1H and ^{13}C NMR (with DEPT) spectra of **3** with those of compounds **1** and **2** showed that sacidumlignan C was an analogue of sacidumlignans A and B, that the main structural differences occurred at C-7, C-8, and C-8′, and these three carbons were all oxygenated. In the HMBC spectrum (Figure 3a), the proton at δ 5.21 (1H, s) strongly correlated with C-1, C-2, C-6, and C-8. It was thus assignable to H-7 attached to the oxygenated carbon at δ 67.6 bearing a hydroxyl group. The chemical shifts of two oxygenated quaternary carbons assigned to C-8 at δ 64.3 and C-8′ at δ 63.1 were considerably deshielded, suggesting the presence of an 8,8′-epoxy group,[9] which was confirmed by the HMBC correlations of H_3-9 to C-8 and C-8′ (or H-9′ to C-8 and C-8′). The HMBC correlation between H-7′ and C-1′ indicated a linkage of C-1′ and C-7′. The relative configuration of **3** was determined by a NOESY spectrum (Figure 3b); the strong interactions between H-7 and H_3-9, H_3-9 and H_3-9′, and H_3-9′ and H-7′ revealed that the H-7, CH_3-9, CH_3-9′, and H-7′ were co-facial and arbitrarily defined as β-oriented. The structure of sacidumlignan C was therefore elucidated as *rel*-(7α,8β,7′α,8′β)-5,7,4′-trihydroxy-4,6,3′,5′-tetramethoxy-8,8′-epoxy-2,7′-cyclolignan.

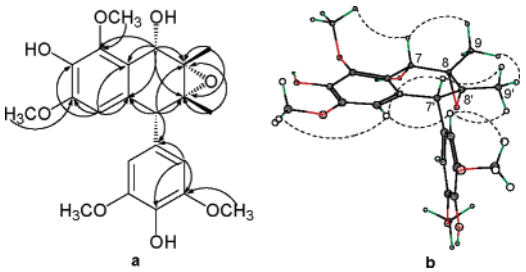

Figure 3. (a) Selected HMBC (H→C) correlations; (b) key NOESY (- - -) correlations and conformation (generated by computer modeling) of sacidumlignan C (**3**).

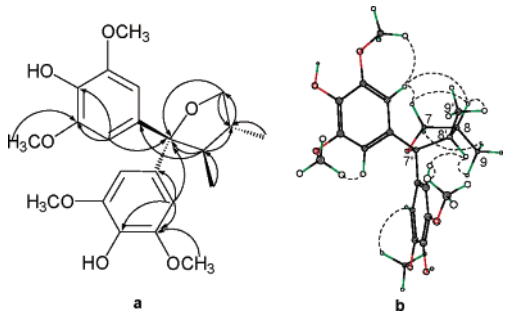

Figure 4. (a) Selected HMBC (H→C) correlations; (b) key NOESY (- - -) correlations and conformation (generated by computer modeling) of sacidumlignan D (**4**).

Sacidumlignan D (**4**) was obtained as a white amorphous powder. The molecular formula was determined as $C_{22}H_{28}O_7$ from its HREIMS at *m/z* 404.1819 $[M]^+$ (calcd 404.1835). The presence of hydroxyls (3421 cm^{-1}) and substituted benzene rings (1612, 1502, and 1460) was observed in its IR spectrum. The 22 carbons were resolved as 16 carbon signals in the ^{13}C NMR, indicating the presence of structurally symmetric subunits in the compound. The ^1H and^{13}C NMR data (Table 2) showed the signals of two symmetrically tetrasubstituted benzene rings, which were defined as two identical 4-hydroxyl-3,5-dimethoxyphenyl moieties on the basis of the HMBC and NOESY spectra (Figure 4). In the ^1H NMR spectrum, the coupling patterns of protons of two methyl groups at δ 0.96 (3H, d, J = 6.5 Hz) and 0.85 (3H, d, J = 6.9 Hz), one oxygenated methylene at δ 4.25 (1H, dd, J = 8.0, 7.7 Hz) and 3.20 (1H, dd, J = 10.0, 8.0 Hz), and two methines at δ 2.40 (1H, dq, J = 9.6, 6.9 Hz) and 2.00 (1H, m) showed the presence of a

Table 1. ^{1}H and ^{13}C NMR Data of Compounds **1**−**3**, **5**, and **6** (in CD_3COCD_3)

	1		**2**		**3**	
	δ_H, *J* (Hz)	δ_C	δ_H, *J* (Hz)	δ_C	δ_H, *J* (Hz)	δ_C
1		123.9		121.3		122.1
2		127.4		127.1		129.6
3	6.56 (1H, s)	101.8	6.47 (1H, s)	109.5	6.49 (1H, s)	108.0
4		149.1		147.8		149.2
5		138.0		138.7		138.2
6		140.6		143.9		146.9
7	7.74 (1H, s)	120.4	6.43 (1H, d, 1.2)	116.0	5.21 (1H, s)	67.6
8		133.7		139.1		64.3
9	2.43 (3H, s)	21.3	1.80 (3H, d, 1.2)	22.6	1.58 (3H, s)	17.0
1′		131.7		137.1		134.8
2′, 6′	6.47 (2H, s)	108.2	6.39 (2H, s)	106.0	7.03 (2H, s)	107.4
3′, 5′		148.8		148.3		148.6
4′		135.6		135.0		134.8
7′		138.6	3.64 (1H, d, 3.0)	51.9	4.09 (1H, s)	54.2
8′		131.7	2.04 (1H, dq, 7.0, 3.0)	42.4		63.1
9′	2.09 (3H, s)	17.5	1.02 (3H, d, 7.0)	18.8	1.20 (3H, s)	18.7
6-OMe	3.95 (3H, s)	60.7	3.79 (3H, s)	60.9	3.86 (3H, s)	60.8
3′, 5′-OMe	3.82 (6H, s)	56.7	3.68 (6H, s)	56.5	3.75 (6H, s)	56.6
4-OMe	3.66 (3H, s)	55.9	3.72 (3H, s)	51.9	3.62 (3H, s)	56.3

	5			**6**	
	δ_H, *J* (Hz)	δ_C		δ_H, *J* (Hz)	δ_C
1	2.38 (3H, s)	25.5	1		140.3
2		199.9	2		137.9
3		127.0	3		149.3
4	7.58 (1H, s)	141.1	4	6.94 (1H, s)	101.6
1′		135.2	4a		127.6
2′, 6′	6.86 (2H, s)	108.5	5	7.43 (1H, s)	126.9
3′, 5′		148.2	6		133.4
4′		137.5	7		133.3
3-Me	2.04 (3H, s)	12.7	8	7.65 (1H, s)	120.6
3′, 5′-OMe	3.84 (6H, s)	56.2	8a		123.6
			6-Me	2.31 (3H, s)	19.6
			7-Me	2.35 (3H, s)	19.9
			1-OMe	3.91 (3H, s)	60.3
			3-OMe	3.91 (3H, s)	55.8

Table 2. ^{1}H, ^{13}C NMR, HMBC, and NOESY of Compound **4** (in CD_3COCD_3)

	δ_H, *J* (Hz)	δ_C	HMBC (H→C)	NOESY (H→H)
1, 3	6.50 (2H, s)	106.6	7′, 5, 2, 6, 4	9′(s), 8 (s), 4, 6-OMe (s), 2′, 6′ (s), 7β (m)
2		137.1		
4, 6		148.1		
5		135.8		
7	7α 3.20 (1H,dd, 10.0, 8.0)	74.3	9, 8	7β (s), 9 (s)
	7β 4.25 (1H, dd, 8.0, 7.7)		8′, 8, 7′	7α (s), 8 (m),1, 3 (w)
8	2.00 (1H, m)	42.3	9′, 7	9′ (s), 9 (s), 1, 3 (w), 7β (m)
9	0.96 (3H, d, 6.5)	15.4	8′, 8, 7	8 (s), 8′ (s), 7α (s)
1′		139.4		
2′, 6′	6.76 (2H, s)	106.3	7′, 4′, 1′, 3′, 5′	9′ (s), 8′ (s), 3′, 5′-OMe (s), 1, 3 (s)
3′, 5′		148.5		
4′		136.2		
7′		91.7		
8′	2.40 (1H, dq, 9.6, 6.9)	51.2	9, 9′, 8, 7′, 2, 1′	9′ (s), 9 (s), 2′, 6′ (s)
9′	0.85 (3H, d, 6.9)	17.0	8, 8′, 7′	8′ (s), 8 (s), 1, 3 (s), 2′, 6′ (s)
4, 6-OMe	3.72 (6H, s)	57.0	4, 6	1, 3 (s)
3′, 5′-OMe	3.78 (6H, s)	57.2	3′, 5′	2′, 6′ (s)

structural fragment −CH(CH_3)−CH(CH_3)−CH_2O−. In the HMBC spectrum (Figure 4a), the correlations of C-7′ with four aromatic protons H-1/H-3 and H-2′/H-6′, and H-8′ at δ 2.40 (1H, dq, J = 9.6, 6.9 Hz) assignable to a methine group, revealed that the two benzene rings and C-8′ were all attached to C-7′; the HMBC correlation between H-7β and C-7′ indicated the presence of a tetrahydrofuran ring, which was supported by the downfield chemical shifts of C-7′ at δ 91.7 and C-7 at δ 74.3.

The relative configuration of **4** was established by a NOESY experiment (see Figure 4b); the key correlations between H-1/H-3 and H-8 and between H-2′/H-6′ and H-8′ clearly indicated that two methyls (Me-9 and Me-9′) were in trans configuration. The structure of sacidumlignan D (**4**) was determined as a rearranged tetrahydrofuran lignan with an unprecedented skeleton, *rel*-(8α,8′β)-5,4′-dihydroxy-4,6,3′,5′-tetramethoxy-1,7-seco-7,7′-epoxy2,7′-cyclolignan.

The molecular formula of sacidumol A (**5**) was determined as $C_{13}H_{16}O_4$ by HREIMS. Comparison the 1D NMR data (Table 1) of **5** with those of compounds **1**−**4** indicated the presence of a 4-hydroxy-3,5-dimethoxyphenyl moiety in compound **5**. The IR absorption at 1645 cm^{-1} and a carbon signal at δ 199.9 in the ^{13}C NMR showed the presence of a carbonyl group linked to a conjugated system.[10] The chemical shifts of C-4 (δ 141.1) and C-3 (δ 127.0) indicated that C-3 was likely attached to the ketone

Table 3. Antimicrobial Activities of Compounds **1** and **2**

microbe	MIC ($\times 10^{-4}$ M)[a]			
	1	**2**	magnolol	pseudolaric acid B
Staphylococcus aureus ATCC 25923	1.3	>1.3	0.47	/
Staphylococcus epidermidis ATCC 12228	0.65	>1.3	0.23	/
Candida albicans ATCC1600	>1.3	>1.3	/	0.14

[a] MIC was defined as the lowest concentration that inhibited visible growth; "/" not tested.

group (C-2) as in the case of an α,*β*-unsaturated ketone,[10] in which the chemical shifts of C-4 and shielded C-3 were affected by the carbonyl C-2. A NOESY experiment indicated that the 4-hydroxy-3,5-dimethoxyphenyl moiety and C-4 were linked together via interactions between H-4 and H-2′/H-6′. The correlations between H-4 and Me-1, H-2′/H-6′, and 3-Me confirmed the location of the two methyls and determined the *E*-geometry of the exocyclic double bond. The structure of sacidumol A was thus elucidated as (3*E*)-4-(4-hydroxy-3,5-dimethoxyphenyl)-3-methylbut-3-en-2-one.

The molecular formula of sacidumol B (**6**) was assigned as $C_{14}H_{16}O_3$ by HREIMS. The UV absorption at 236 nm (log ϵ 4.68) and 288 nm (log ϵ 3.69) revealed that compound **6** had a naphthalene core. The IR spectrum showed the presence of a hydroxyl group (3419 cm^{-1}) and aromatic ring (1616 and 1485 cm^{-1}). Comparison of the ^1H and ^{13}C NMR data of **6** with those of compound **1** revealed that sacidumol B (**6**) was likely a degraded derivative of compound **1** by the loss of the substituted aromatic ring at C-7′. The structure of **6** was finally confirmed by a NOESY experiment via correlations of 1-OMe/H-8, H-8/7-Me, 7-Me/6-Me, 6-Me/H-5, H-5/H-4, and H-4/3-OMe. The structure of sacidumol B was therefore elucidated as 1,3-dimethoxy-6,7-dimethylnaphthalen-2-ol.

Four known compounds, (+)-pinoresinol,[11] 9α-hydroxypinoresinol,[11] perforatic acid,[12] and peucenin-7-*O*-methyl ether,[13] were identified on the basis of spectroscopic methods (IR, EI MS, ^1H NMR, and ^{13}C NMR).

Compounds **1** and **2** were evaluated for antimicrobial activities against two pathogenic bacteria, *Staphylococcus aureus* and *Staphylococcus epidermidis*, and one fungus, *Candida albicans*, by a microdilution assay. Two potent natural antimicrobial agents, magnolol[14] and pseudolaric acid B,[15] were used as positive controls for antibacterial and antifungal tests, respectively. Compound **1** showed moderate antimicrobial activities against *S. aureus* and *S. epidermidis* at the level of MICs, $(0.65-1.3) \times 10^{-4}$ M (Table 3).

Experimental Section

General Experimental Procedures. Optical rotations were measured on a Perkin-Elmer 341 polarimeter. IR spectra were recorded on a Perkin-Elmer 577 spectrometer with KBr disks. NMR spectra were measured on a Bruker AM-400 spectrometer with TMS as internal standard. EI-MS (70 eV) was carried out on a Finnigan MAT95 mass spectrometer. All solvents were of analytical grade (Shanghai Chemical Plant, Shanghai, People's Republic of China). Silica gel (200−300 mesh) was used for column chromatography, and precoated silica gel GF254 plates (Qingdao Haiyang Chemical Plant, Qingdao, People's Republic of China) were used for TLC. C18 reversed-phase silica gel (150−200 mesh, Merck), MCI gel (CHP20P, 75−150 μm, Mitsubishi Chemical Industries Ltd.), and Sephadex LH-20 gel (Amersham Biosciences) were also used for column chromatography.

Plant Material. *S. acidum* was collected from Hainan Province of People's Republic of China and authenticated by Prof. Shi-Man Huang, Department of Biology, Hainan University of People's Republic of China. A voucher specimen has been deposited in Shanghai Institute of Materia Medica, SIBS, Chinese Academy of Sciences (accession number SA-2003-1Y).

Extraction and Isolation. The air-dried and powdered whole plant of *S. acidum* (2.1 kg) was percolated with 95% EtOH at room temperature. After removal of the solvent under reduced pressure, the crude extract (198 g) was dissolved in 80% MeOH, which was partitioned with petroleum ether and EtOAc successively to give two fractions, SA-P (116 g) and SA-E (50 g), respectively. The SA-P part mainly contained waxy fatty acids. The SA-E part was subjected to an MCI gel CHP 20P column eluted with H_2O−MeOH (1: 1 to 0: 1) to afford fractions, E1−E6. Fraction E1 was purified by column chromatography on C18 reversed-phase silica gel eluted with 70% MeOH to obtain perforatic acid (30 mg). Fraction E2 was separated on a silica gel column eluted with a mixture of petroleum ether−EtOAc−MeOH (1:1:0.2) to give two major fractions, E2a and E2b, each of which was then chromatographed on a C18 reversed-phase silica gel column eluted with 50% MeOH to give **3** (15 mg) and 9α-hydroxypinoresinol (12 mg), respectively. Fraction E3 was separated on silica gel eluted with petroleum ether−EtOAc−HCOOH (7:2:0.1) to yield **2** (60 mg) and three subfractions, E3a−E3c. Subfraction E3a was further purified on Sephadex LH-20 eluted with 70% MeOH to give **5** (15 mg). Subfraction E3b was separated on silica gel eluted with petroleum ether−acetone (5:1) to give **4** (10 mg). Subfraction E3c was purified by a C18 reversed-phase silica gel column eluted with 50% MeOH to afford (+)-pinoresinol (50 mg). Purification of fraction E4 on a silica gel column eluted with $CHCl_3$−MeOH (10:1) afforded **1** (100 mg). Fraction E5 was subjected to a silica gel column eluted with a mixture of solvents, petroleum ether−EtOAc−HCOOH (5:2:0.1), to collect the major compound, which was then purified on Sephadex LH-20 to obtain **6** (12 mg). Fraction E6 was chromatographed over Sephadex LH-20 to give a major compound, which was further purified by a C18 reversed-phase silica gel column eluted with 85% MeOH to afford peucenin-7-*O*-methyl ether (12 mg).

Sacidumlignan A (1): colorless needles; UV (MeOH) λ_{max} (log ϵ) 205 (4.81), 239 (4.94), 290 (3.97), 331 (3.38) nm; IR (KBr) ν_{max} 3425, 2933, 1611, 1495, 1451, 1290 cm^{-1}; ^1H NMR and ^{13}C NMR, see Table 1; EIMS 70 eV *m/z* (rel int) 384 $[M]^+$ (100), 369 (7), 351 (8), 337 (25), 309 (6), 291 (10), 277 (6); HREIMS *m/z* 384.1575 (calcd for $C_{22}H_{24}O_6$, 384.1573).

Methylation of Sacidumlignan A (1). 1 (20 mg) was dissolved in 5 mL of acetone, and then 2 mL of CH_3I as well as 100 mg of anhydrous Na_2CO_3 were added at room temperature. The reaction mixture was stirred for 24 h, and a yellow solid containing one major compound was obtained after workup. The crude product was purified by silica gel chromatography eluted with petroleum ether−acetone (5:1) to give **1a** (15 mg). Compound **1a**: white amorphous powder; ^1H NMR (CD_3COCD_3, 400 MHz) δ 7.87 (1H, s), 6.50 (1H, s), 6.47 (2H, s), 4.06 (3H, s, OMe), 3.96 (3H, s, OMe), 3.95 (3H, s, OMe), 3.83 (6H, s, OMe), 3.70 (3H, s, OMe), 2.48 (3H, s), 2.14 (3H, s).

Sacidumlignan B (2): white amorphous powder; $[\alpha]^{20}_D$ −116° (*c* 1.44, acetone); UV (MeOH) λ_{max} (log ϵ) 204 (4.69), 279 (4.06) nm; IR (KBr) ν_{max} 3493, 2963, 1619, 1495, 1424, 1305, 1219 cm^{-1}; ^1H NMR and ^{13}C NMR, see Table 1; EIMS 70 eV *m/z* (rel int) 386 $[M]^+$ (100), 371 (22), 355 (7), 339 (18), 311 (10), 279 (7), 232 (24), 217 (16), 181 (12); HREIMS *m/z* 386.1733 (calcd for $C_{22}H_{26}O_6$, 386.1729).

Sacidumlignan C (3): white amorphous powder; $[\alpha]^{20}_D$ −72° (*c* 0.5, acetone); UV (MeOH) λ_{max} (log ϵ) 204 (4.97), 274 (3.53) nm; IR (KBr) ν_{max} 3433, 2937, 1618, 1502, 1460 1327,

1217 cm^{-1}; ^1H NMR and ^{13}C NMR, see Table 1; EIMS 70 eV *m/z* (rel int) 418 $[M]^+$ (100), 400 (15), 357 (70), 343 (8), 251 (12), 237 (8), 221 (12), 181 (10); HREIMS *m/z* 418.1627 (calcd for $C_{22}H_{26}O_8$, 418.1628).

Sacidumlignan D (4): white amorphous powder; $[\alpha]^{20}_D$ −115° (*c* 1.14, acetone); UV (MeOH) λ_{max} (log ϵ) 204 (4.85), 273 (3.50) nm; IR (KBr) ν_{max} 3421, 2931, 1612, 1502, 1460, 1327, 1215 cm^{-1}; ^1H NMR and ^{13}C NMR, see Table 2; EIMS 70 eV *m/z* (rel int) 404 $[M]^+$ (29), 334 (100), 303 (15), 251 (8), 181 (29), 153 (3), 69 (2), 57 (2); HREIMS *m/z* 404.1819 (calcd for $C_{22}H_{28}O_7$, 404.1835).

Sacidumol A (5): white amorphous powder; UV (MeOH) λ_{max} (log ϵ) 325 (4.08), 236 (4.05) nm; IR (KBr) ν_{max} 3396, 2937, 1721, 1645, 1598, 1516, 1115 cm^{-1}; ^1H NMR and ^{13}C NMR, see Table 1; EIMS 70 eV *m/z* (rel int) 236 $[M]^+$ (100), 221 (17), 205 (78), 189 (44), 181 (12), 161 (25), 133 (22), 105 (19), 77 (15); HREIMS *m/z* 236.1035 (calcd. for $C_{13}H_{16}O_4$, 236.1049).

Sacidumol B (6): white amorphous powder; UV (MeOH) λ_{max} (log ϵ) 236 (4.68), 288 (3.69) nm; IR (KBr) ν_{max} 3419, 2937, 1616, 1485, 1292 cm^{-1}; ^1H NMR and ^{13}C NMR, see Table 1; EIMS 70 eV *m/z* (rel int) 232 $[M]^+$ (97), 217 (100), 185 (28), 174 (20), 128 (10); HREIMS *m/z* 232.1097 (calcd. for $C_{14}H_{16}O_3$, 232.1099).

Microdilution Assays for Antimicrobial Evaluation. Bioassays on antibacterial activities against *S. aureus* and *S. epidermidis* and antifungal tests against *C. albicans* in vitro were carried out according to the protocols described.[16] For *S. aureus* and *S. epidermidis*, the microbial cells were suspended in Mueller Hinton broth to form a final density of 5×10^5−10^6 CFUs/mL and incubated at 37 °C for 18 h under aerobic conditions with the respective compounds which were dissolved in DMSO. *C. albicans* (10^4−10^5 CFUs/mL) were grown in Sabouraud dextrose broth at 37 °C for 48 h with the respective compounds which were dissolved in DMSO. The blank controls of microbial culture were incubated with limited DMSO under the same conditions. DMSO was not toxic at a limited amount under the experimental conditions. The 2-fold serial broth dilution assay was applied to measure the MIC values. MIC was defined as the lowest concentration that inhibited visible growth, and the MIC > 1.3×10^{-4} M was considered to be inactive. The MIC values were the average of a parallel of three measurements.

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Supporting Information Available: ^1H NMR, ^1C NMR, EIMS, HMBC, and NOESY spectra of compounds **1**−**4**. ^1H NMR, ^1C NMR, EIMS, and NOESY spectra of compounds **5** and **6**. This material is available free of charge via the Internet at http://pubs.acs.org.

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