New Nardosinanes and 19-Oxygenated Ergosterols from the Soft Coral *Nephthea armata* Collected in Taiwan

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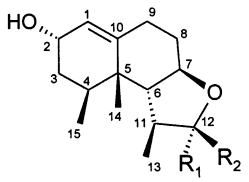
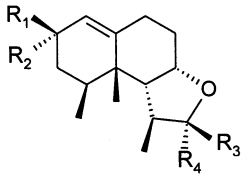
Received March 26, 2004

Five new nardosinane sesquiterpenoids, armatins A−E (**1**−**5**), lemnal-1(10)-ene-2,12-dione (**6**) (a new natural product), and two new cytotoxic 19-oxygenated ergosterols, armatinols A and B (**7** and **8**), were isolated from the methylene chloride extract of the soft coral *Nephthea armata*, collected in Taiwan. The structures were elucidated by 1D and 2D NMR spectral analysis, and their cytotoxicity was determined against selected cancer cells.

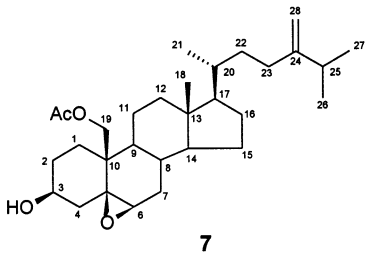
The soft corals of the genus *Nephthea* are rich in terpenoids[1−11] and steroids.[12] As part of our search for bioactive substances from marine organisms, the soft coral *Nephthea armata* Thomson and Dean (family Nephtheidae), collected in Taiwan, was studied because its CH_2Cl_2 extract showed significant cytotoxicity to A549 (human lung adenocarcinoma), HT-29 (human colon adenocarcinoma), and P-388 (mouse lymphocytic leukemia) cell cultures, as determined by standard procedures.[13,14] Bioassay-guided fractionation resulted in the isolation of five new nardosinane sesquiterpenoids, armatins A−E (**1**−**5**), the new natural product lemnal-1(10)-ene-2,12-dione (**6**), and two new cytotoxic 19-oxygenated ergosterols, armatinols A and B (**7** and **8**).



1 R_1 = OH, R_2 = H
2 R_1,R_2 = O
3 R_1 = OMe, R_2 = H



4 R_1 = H, R_2 = OH, R_3 = OMe, R_4 = H
5 R_1,R_2 = O, R_3 = OMe, R_4 = H
6 R_1,R_2 = O, R_3,R_4 = O



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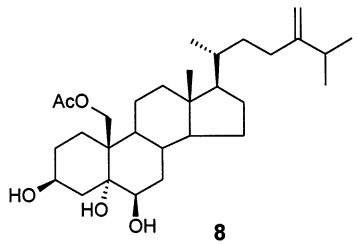

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Results and Discussion

Armatin A (**1**) was isolated as a colorless amorphous solid. HREIMS, ^{13}C NMR, and DEPT spectra established the molecular formula of **1** as $C_{15}H_{24}O_3$. Thus, four degrees of unsaturation were determined for **1**. The ^{13}C NMR and DEPT spectra of **1** exhibited signals for three methyls, three sp^3 methylenes, six sp^3 methines, one sp^2 methine, one sp^3 quaternary carbon, and one sp^2 quaternary carbon. The presence of a secondary hydroxyl group in **1** was indicated from the IR (3450 cm^{-1}) and NMR data (δ_H 3.95 m; δ_C 63.5 d) (Tables 1 and 2). The presence of two sp^2 hybridized carbon atoms in the molecule, as deduced from the ^{13}C and DEPT NMR spectra (Table 2), corresponding to one carbon−carbon double bond as the only multiple bond, indicated compound **1** to be tricyclic. The ^1H NMR spectrum contained signals for three methyl groups, two doublets (δ_H 0.98, 1.25), and one singlet (δ_H 0.97). In addition, a signal at δ_H 5.03 was attributed to a proton on a carbon carrying two oxygens and confirmed by ^{13}C NMR spectroscopy (δ_C 107.0 d). The presence of another carbon bearing an oxygen (δ_C 76.3 d) was shown in the ^{13}C NMR spectrum. The spectral data of **1** exhibited some similarities to those of a nardosinane sesquiterpene hemiacetal isolated from *Lemnalia africana*.[15] Measurement of the $^{13}C-^{13}C$ homonuclear shift correlation 2D NMR spectrum (INADEQUATE) (Figure S1) of **1** together with COSY, HMQC, and HMBC (Table S1) experiments established its entire carbon skeleton and enabled also the assignment of all resonances in the ^{13}C NMR spectra. The α-configuration of hydroxy at C-2 was determined by comparison with $J_{1,2}$ of lemnacarol ($J_{1,2}$ = 6 Hz) and its 2-epimeric analogues

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10.1021/np0400858 CCC: $27.50
Published on Web 07/14/2004

Table 1. ^{1}H NMR Data of **1**−**6**[a]

H	1	2	3	4	5	6
1	5.50 d (4.5)	5.60 d (4.8)	5.54 d (4.5)	5.49 d (4.2)	5.81 br s	5.97 br s
2	3.95 m	4.06 m	4.01 m	4.03 m		
3	1.62 m	1.71 m	1.68 m	1.77 m	2.33 m	2.37 m
4	2.08 m	2.02 m	2.06 m	1.97 m	2.34 m	2.34 m
6	1.53 m	1.91 t (12.3)	1.59 m	1.98 m	2.14 m	2.61 m
7	3.97 m	4.01 m	3.80 m	3.76 m	3.80 m	4.89 m
8α	2.07 m	2.29 m	2.09 m	1.56 m	1.76 m	1.80 m
8*β*	1.52 m	1.68 m	1.53 m	2.11 m	2.20 m	2.25 m
9α	1.98 dd (18.8, 10.2)	2.09 m	2.01 m	2.02 m	2.22 m	2.38 m
9*β*	2.46 dd (18.8, 12.0)	2.53 dd (18.5, 10.5)	2.51 m	2.54 m	2.73 m	2.59 m
11	2.13 m	2.59 dq (12.3, 6.3)	2.20 m	2.20 m	2.18 m	2.37 m
12	5.03 d (3.3)		4.63 d (3.3)	4.75 d (5.1)	4.77 d (4.7)	
13	1.25 d (6.6)	1.42 d (6.9)	1.27 d (6.6)	1.17 d (6.6)	1.20 d (6.0)	1.40 d (6.9)
14	0.97 s	1.05 s	1.00 s	1.02 s	1.21 s	1.24 s
15	0.98 d (6.0)	1.00 d (6.3)	1.00 d (6.3)	1.03 d (6.0)	1.12 d (5.7)	1.04 d (6.0)
OMe			3.36 s	3.35 s	3.63 s	

[a] Recorded in $CDCl_3$ at 300 MHz.

Table 2. ^{13}C NMR Spectral Data[a] (*δ*) of **1**−**6** in $CDCl_3$

	1	2	3	4	5	6
1	123.3	124.5	123.2	123.1	125.6	128.0
2	63.5	63.6	63.8	63.9	196.9	197.8
3	38.0	37.6	37.8	38.1	43.7	41.6
4	26.3	26.1	26.4	26.1	32.9	35.6
5	40.3	40.6	40.2	41.0	42.3	42.3
6	59.9	56.7	59.6	54.8	54.8	49.4
7	76.3	75.4	76.4	78.7	78.1	75.0
8	29.8	29.3	29.6	32.0	31.2	27.2
9	27.4	26.6	27.5	27.9	29.0	27.9
10	147.8	146.6	148.5	149.6	173.4	165.1
11	44.1	38.7	42.8	40.6	40.8	36.9
12	107.0	179.4	113.8	108.9	108.8	179.8
13	18.6	16.2	18.6	13.6	13.3	18.0
14	19.9	19.3	20.0	19.3	19.0	19.0
15	18.9	17.7	19.0	18.3	18.2	15.5
OMe			55.6	54.9	54.8	

[a] Recorded in $CDCl_3$ at 75 MHz (assigned by DEPT, COSY, HSQC, and HMBC experiments).

($J_{1,2}$ = 0 Hz).[15] The relative stereochemistry of **1** was deduced from a 2D NOESY experiment (Table S2), which indicated that Me-13, Me-14, Me-15, H-6, and H-12 are on one side of the molecule, while H-4, H-7, and H-11 are on the opposite side of the molecule. From the aforementioned data, armatin A can be formulated as (7αH)-lemnal-1(10)-ene-2α,12α-diol.

Armatin B (**2**) was isolated as a colorless amorphous solid, whose molecular formula, $C_{15}H_{22}O_3$, was revealed by HREIMS and NMR spectra. The IR spectrum showed the presence of a lactone (1745 cm^{-1}) and a secondary hydroxyl group (3515 cm^{-1}). The ^{13}C NMR features (Table 2) of **2** closely resembled those of **1** except that the resonances for the hemiacetal in **1** were replaced by those of a *γ*-lactone in **2**. HMBC correlations from H-13 to C-6/C-11/C-12; from H-6 to C-5/C-7/C-8/C-13/C-14; and from H-11 to C-5/C-6/C-13 confirmed the position of the *γ*-lactone in **2**. The α-configuration of hydroxy at C-2 was determined by comparison with $J_{1,2}$ of lemnacarol and its 2-epimeric analogues.[15] The relative stereochemistry of **2** was deduced from a 2D NOESY experiment (Table S2), which indicated that Me-13, Me-14, Me-15, and H-6 are on one side of the molecule, while H-4, H-7, and H-11 are on the opposite side of the molecule (Figure 1). From the aforementioned data, amatin B was formulated as 2α-hydroxy-(7α*H*)-lemnal-1(10)-en-12-one.

Armatin C (**3**) had the molecular formula $C_{16}H_{26}O_3$, as determined by HREIMS and NMR spectral data (Tables 1 and 2). The EIMS and NMR spectra showed that **3** is a *O*-methyl derivative of **1**. The NMR chemical shifts of **3** were very close to those of **1** except that the hydroxyl was replaced by a methoxyl group at C-12. HMBC correlations (Table S1) from H-12 and C-6/C-7/C-11/C-13/OCH_3 and from H-11 to C-5/C-12/C-13/OCH_3 enable the correct positioning of the methoxyl group. The α-configuration of hydroxy at C-2 was determined by comparison with $J_{1,2}$ of lemnacarol and its 2-epimeric analogues.[15] The relative stereochemistry of **3** was deduced from a 2D NOESY experiment (Table S2), which indicated that Me-13, Me-14, Me-15, H-6, and H-12 are on one side of the molecule, while H-4, H-7, and H-11 are on the opposite side of the molecule. The structure of armatin C (**3**) was thus formulated as 12α-methoxy-(7αH)-lemnal-1(10)-en-2α-ol.

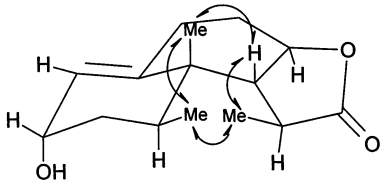

Figure 1. Key NOESY correlations of **2**.

Armatin D (**4**) analyzed for $C_{16}H_{26}O_3$ by HREIMS and NMR spectral data. The IR spectrum showed the presence of a hydroxyl (3450 cm^{-1}) group. The EIMS and NMR spectra showed that **4** is a stereoisomer of **3**. The spectroscopic data of **4** were similar to those of **3** with the exception of signals in the vicinity of the five-membered ring. The α-configuration of the hydroxy at C-2 was determined by comparison with $J_{1,2}$ of lemnacarol and its 2-epimeric analogues.[15] The relative stereochemistry of **4** was deduced from a 2D NOESY experiment (Table S2), which indicated that Me-13, Me-14, Me-15, H-6, H-7, and OMe are on one side of the molecule, while H-4, H-11, and H-12 are on the opposite side of the molecule. The structure of armatin D was thus formulated as 12*β*-methoxylemnal-1(10)-en-2α-ol.

Armatin E (**5**) was isolated as a colorless amorphous solid of molecular formula $C_{16}H_{24}O_3$, as indicated by HREIMS and ^{13}C NMR (Table 2) spectral methods. The spectroscopic data of **5** were analogous to those of **4** with the exception that the resonances for the secondary hydroxyl in **4** were replaced by those of a ketone in **5**. HMBC correlations (Table S1) from H-1 to C-2/C-3/C-9; from H-3 to C-2/C-1; and from H-4 to C-2/C-3/C-6 helped ascertain the position of the α,*β*-unsaturated ketone group. The relative stereochemistry of **5** was deduced from a 2D NOESY experiment (Table S2), which indicated that Me-13, Me-14, Me-15, H-6, H-7, and OMe are on one side of the molecule, while H-4, H-11, and H-12 are on the opposite side of the molecule.

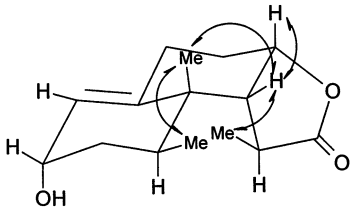

Figure 2. Key NOESY correlations of **6**.

The structure of armatin E was thus formulated as 12β-methoxylemnal-1(10)-en-2-one.

Compound **6** was isolated as a colorless amorphous solid and analyzed for $C_{15}H_{20}O_3$ by HREIMS and NMR spectral data (Tables 1 and 2). The ^{13}C NMR features (Table 2) of **6** closely resembled those of **5**, except the resonances for the methoxyl in **5** were replaced by a carbonyl in **6**. HMBC correlations from H-13 to C-6/C-11/C-12; from H-6 to C-5/C-7/C-13/C-14; and from H-11 to C-5/C-6/C-13 confirmed the position of the lactone in **6**. The relative stereochemistry of **6** was deduced from a 2D NOESY experiment (Table S2), which indicated that Me-13, Me-14, Me-15, H-6, and H-7 were on one side of the molecule, while H-4 and H-11 were on the opposite side of the molecule (Figure 2). The ^1H NMR data of **6** were identical with those of lemnal-1(10)-ene-2,12-dione, a Jones oxidation product of lemnal-1(10)-ene-2β,12β-diol, which was isolated from the soft coral *Lemnaol africana*.[15] ^{13}C NMR data and detailed assignments of ^1H NMR data of **6** were not reported previously.

Armatinol A (**7**) was assigned a molecular formula of $C_{30}H_{48}O_4$, as indicated by HREIMS. The ^{13}C NMR and DEPT spectra of **7** exhibited the presence of signals for four methyls, 10 sp^3 methylenes, eight sp^3 methines, one sp^2 methylene, three sp^3 quaternary carbons, and one sp^2 quaternary carbon. The presence of a terminal methylene was indicated by the ^1H NMR [δ 4.66 (1H, s), 4.72 (1H, s)] and the ^{13}C NMR [δ 106.0 (CH), 156.9 (C)] spectra. The IR absorption at 1730 cm^{-1} and the ^1H NMR signal at δ 3.79 (1H, m) as well as the ^{13}C NMR signal at δ 68.8 (CH) indicated the presence of a secondary hydroxyl group. The presence of a primary acetoxy group was indicated by ^1H NMR [δ 4.08 (1H, d, J = 11.4 Hz), 4.46 (1H, d, J = 11.4 Hz), and 2.10 (3H, s)] and ^{13}C NMR [δ 66.0 (CH_2), 21.4 (CH_3), 171.1 (C)] spectra. The ^{13}C NMR signals at δ 61.4 (CH) and 61.0 (C) and ^1H NMR signal at δ 2.98 (1H, br s) showed the presence of a trisubstituted epoxy ring. The spectral data of **7** exhibited some similarities to values for 5,6-epoxylitosterol,[16] except for the presence of a primary acetoxy in **7** instead of a primary hydroxy in 5,6-epoxylitosterol. The placement of the acetoxy group at C-19 was made on the basis of HMBC correlations from H-19 to C-5/C-9/C-10 and from H_3-OAc to the ester carbonyl carbon. The epoxy group was placed at C-5 and C-6 on the basis of $^1H-^1H$ COSY correlations from H-6 to H-7 and from H-7 to H-8 and HMBC correlations from H-3 to C-2/C-5 and from H-6 to C-4/C-7/C-8. The NOESY correlations (Figure 3) observed between H_2-19 and H-8/H-12β; H-4α and H-6/H-3; H-3 and H-1α/H-2; H-9 and H-7α/H-14; H_3-18 and H-20/H-8/H-12β; and H_3-21 and H-12β indicated the relative configurations for each ring junction and chiral center. The stereochemistry at C-20 was confirmed by comparison of ^{13}C NMR data with those of 5,6-epoxylitosterol.[16] The structure of armatinol A was thus formulated as 19-acetoxy-5β,6β-epoxy-24-methylenecholestan-3β-ol.

HREIMS and ^{13}C NMR data revealed armatinol B (**8**) to have a molecular formula of $C_{30}H_{50}O_5$. The ^{13}C and ^1H NMR data showed some similarities to those of **7**, except for the presence of two additional hydroxyls and the absence of a trisubstituted epoxy unit. The location of the hydroxyls on C-5 and C-6 was made on the basis of $^1H-^1H$ COSY correlations from H-6 to H-7 and from H-7 to H-8 and HMBC correlations from H-3 to C-2/C-4/C-5 and from H-6 to C-4/C-5/C-7/C-8. The NOESY correlations (Figure 4) observed between H_2-19 and H-8/H-1β/12β; H-4α and H-6/H-3; H-3 and H-1α/H-2; H-8 and H-7β/H_3-18; H-9 and H-7α/H-14; H_3-18 and H-20/12β/H-8; and H_3-21 and H-12β indicated the relative configurations for each ring junction and chiral center. The stereochemistry at C-20 was confirmed by comparison of ^{13}C NMR data with those of 5,6-epoxylitosterol.[16] The structure of armatinol B was thus formulated as 19-acetoxy-24-methylenecholestan-3β,5α,6β-triol.

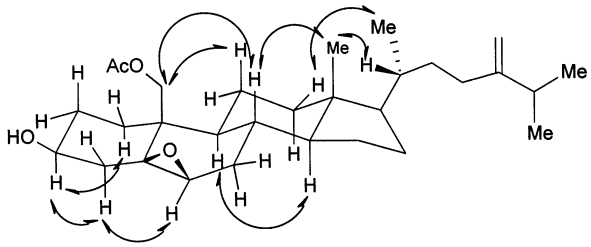

Figure 3. Key NOESY correlations of **7**.

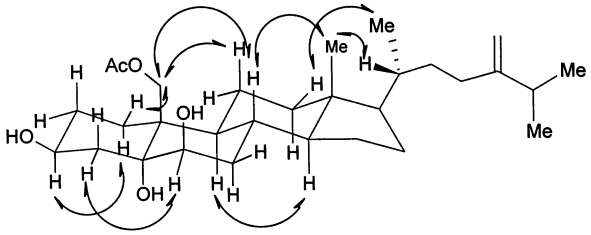

Figure 4. Key NOESY correlations of **8**.

Armartnol A (**7**) exhibited cytotoxicity against A-549, HT-29, and P-388 cells with IC_{50} value of 7.6, 6.5, and 6.1 μM, respectively. Armatinol B (**8**) showed cytotoxicity against P-388 and HT-29 cells with IC_{50} values of 3.2 and 3.1 μM, respectively. The IC_{50} values of compounds **1**−**6** against P-388, HT-29, and A-549 were greater than 50 μM.

Experimental Section

General Experimental Procedures. Melting points were determined using a Yanagimoto micromelting point apparatus and are reported uncorrected. Optical rotations were determined on a JASCO DIP-181 polarimeter. UV spectra were obtained on a Shimadzu UV-160A spectrophotometer, and IR spectra were recorded on a Hitachi 26-30 spectrophotometer. The NMR spectra were recorded on a Bruker Avance 300 NMR spectrometer at 300 MHz for ^1H and 75 MHz for ^{13}C, respectively, in $CDCl_3$ using TMS as internal standard. The EIMS were obtained with a JEOL JMS-SX/SX 102A mass spectrometer at 70 eV. Si gel 60 (Merck, 230−400 mesh) was used for column chromatography; precoated Si gel plates (Merck, Kieselgel 60 F_{254}, 0.25 mm) were used for TLC analysis.

Animal Material. The soft coral *N. armata* was collected at Green Island, off Taiwan, in March 2002, at a depth of 5 m and was stored for 1 week in a freezer until extraction. A voucher specimen, NSUGN-050, was deposited in the Department of Marine Resources, National Sun Yat-sen University, Taiwan.

Extraction and Isolation. The bodies of the soft coral *N. armata* were freeze-dried to give 1.75 kg of a solid, which was extracted with CH_2Cl_2 (2.0 L × 3). After removal of solvent in vacuo, the residue (27 g) was chromatographed over Si gel 60 using *n*-hexane−EtOAc and MeOH−EtOAc mixtures as eluting solvents. Elution by *n*-hexane−EtOAc (3:7) afforded frac-

tions containing **1**, **3**−**5**, and **8**. Elution by MeOH−EtOAc (5:95) afforded fractions containing **2**, **6**, and **7**. Compound **1** was further purified by Si gel column chromatography, by eluting with MeOH−CH_2Cl_2 (12:88). Compound **8** was further purified by Si gel column chromatography, by eluting with MeOH−CH_2Cl_2 (25:75). Compounds **3**−**5** were further purified by C_{18} HPLC column chromatography, by eluting with MeOH−H_2O (67:33). Compound **2** was further purified by Si gel column chromatography, with *n*-hexane−EtOAc (1:1) used as solvent. Compound **7** was further purified by Si gel column chromatography, by eluting with acetone−CH_2Cl_2 (2:8). Compound **6** was obtained by C_{18} HPLC column, using MeOH−H_2O (65:35) as solvent system.

Armatin A (1): colorless amorphous solid; $[\alpha]^{25}_D$ −106° (*c* 0.4, $CHCl_3$); UV (MeOH) λ_{max} (log ϵ) 205 (3.4) nm; IR (KBr) ν_{max} 3450 cm^{-1}; ^1H NMR, see Table 1; ^{13}C NMR, see Table 2; EIMS *m*/*z* 252 $[M]^+$ (2), 234 (8), 216 (12), 201 (18), 187, 120 (100); HREIMS *m*/*z* 252.1712 (calcd for $C_{15}H_{24}O_3$, 252.1719).

Armatin B (2): colorless amorphous solid; $[\alpha]^{25}_D$ −243° (*c* 0.8, $CHCl_3$); UV (MeOH) λ_{max} (log ϵ) 207 (3.5) nm; IR (KBr) ν_{max} 3515, 1745 cm^{-1}; ^1H NMR, see Table 1; ^{13}C NMR, see Table 2; EIMS *m*/*z* 250 $[M]^+$ (1), 232 (5), 221 (2), 167 (28), 136 (23), 121 (50), 107 (62), 83 (100); HREIMS *m*/*z* 250.1558 (calcd for $C_{15}H_{22}O_3$, 250.1563).

Armatin C (3): colorless amorphous solid; $[\alpha]^{25}_D$ −198° (*c* 0.4, $CHCl_3$); UV (MeOH) λ_{max} (log ϵ) 209 (3.9) nm; IR (KBr) ν_{max} 3385 cm^{-1}; ^1H NMR, see Table 1; ^{13}C NMR, see Table 2; EIMS *m*/*z* 266 $[M]^+$ (3), 248 (18), 173 (35), 147 (63), 119 (78), 55 (100); HREIMS *m*/*z* 266.1870 (calcd for $C_{16}H_{26}O_3$, 266.1875).

Armarin D (4): colorless oil; $[\alpha]^{25}_D$ −178° (*c* 0.1, $CHCl_3$); UV (MeOH) λ_{max} (log ϵ) 204 (3.6) nm; IR (KBr) ν_{max} 3450 cm^{-1}; ^1H NMR, see Table 1; ^{13}C NMR, see Table 2; EIMS *m*/*z* 266 $[M]^+$ (4), 248 (26), 175 (32), 147 (60), 119 (82), 105 (76), 55 (100); HREIMS *m*/*z* 266.1868 (calcd for $C_{16}H_{26}O_3$, 266.1875).

Armatin E (5): colorless amorphous solid; $[\alpha]^{25}_D$ −28° (*c* 0.2, $CHCl_3$); UV (MeOH) λ_{max} (log ϵ) 239 (4.7) nm; IR (KBr) ν_{max} 1730 cm^{-1}; ^1H NMR, see Table 1; ^{13}C NMR, see Table 2; EIMS *m*/*z* 264 $[M]^+$ (3), 234 (13), 207 (18), 189 (47), 69 (100); HREIMS *m*/*z* 264.1711 (calcd for $C_{16}H_{24}O_3$, 264.1719).

Armatin F (6): colorless amorphous solid; $[\alpha]^{25}_D$ −11° (*c* 0.2, $CHCl_3$); UV (MeOH) λ_{max} (log ϵ) 246 (4.3) nm; IR (KBr) ν_{max} 1750, 1730 cm^{-1}; ^1H NMR, see Table 1; ^{13}C NMR, see Table 2; EIMS *m*/*z* 248 $[M]^+$ (6), 232 (2), 206 (18), 175 (20), 133 (43), 91 (60), 69 (100); HREIMS *m*/*z* 248.1398 (calcd for $C_{15}H_{20}O_3$, 248.1407).

Armatinol A (7): colorless amorphous solid; $[\alpha]^{25}_D$ −6.2° (*c* 0.4, $CHCl_3$); UV (MeOH) λ_{max} (log ϵ) 206 (3.5) nm; IR (KBr) ν_{max} 3465, 1730 cm^{-1}; ^1H NMR ($CDCl_3$, 300 MHz) δ 0.67 (3H, s, H_3-18), 0.72 (1H, m, H-9), 0.86 (1H, m, H-14), 0.93 (3H, d, J = 6.3 Hz, H_3-21), 1.02 (3H, d, J = 6.9 Hz, H_3-26), 1.03 (3H, d, J = 6.3 Hz, H_3-27), 1.04 (1H, m, H-12α), 1.17 (1H, m, H-22), 1.30 (1H, m, H-16), 1.32 (1H, m, H-7α), 1.39 (1H, m, H-2α), 1.41 (1H, m, H-2α), 1.43 (1H, m, H-20), 1.45 (1H, m, H-23), 1.49 (1H, m, H-11), 1.52 (1H, m, H-4α), 1.55 (1H, m, H-11), 1.57 (1H, m, H-22), 1.59 (1H, m, H-8), 1.63 (1H, m, H-15), 1.88 (1H, m, H-2*β*), 2.02 (1H, m, H-12*β*), 2.08 (1H, m, H-1*β*), 2.10 (3H, s, OAc), 2.17 (1H, m, H-7), 2.24 (1H, m, H-25), 2.26 (1H, m, H-4*β*), 2.98 (1H, br s, H-6), 3.79 (1H, m, H-3), 4.08 (1H, d, J = 11.4 Hz, H-19), 4.46 (1H, J = 11.4 Hz, H-19), 4.66 (1H, s, H-28), 4.72 (1H, s, H-28); ^{13}C NMR ($CDCl_3$, 75 MHz) δ 11.8 q (C-18), 18.7 q (C-21), 21.4 q (OAc), 21.9 q (C-26, 27), 22.1 t (C-11), 24.2 t (C-15), 28.2 t (C-16), 30.4 d (C-8), 31.0 t (C-23), 31.3 t (C-2), 32.5 t (C-1), 32.9 t (C-7), 33.9 d (C-25), 34.7 t (C-22), 35.8 d (C-20), 37.9 s (C-10), 40.0 t (C-12), 43.4 t (C-13), 42.7 t (C-4), 50.2 d (C-9), 56.0 d (C-17), 56.5 d (C-14), 61.0 s (C-5), 61.4 d (C-6), 66.0 t (C-19), 68.8 d (C-3), 106.0 t (C-28), 156.9 s (C-25), 171.1 s (OAc); EIMS *m*/*z* 472 $[M]^+$ (2), 454 (8), 412 (15), 396 (13), 328 (10), 310 (24), 55 (100); HREIMS *m*/*z* 472.3533 (calcd for $C_{30}H_{48}O_4$, 472.3540).

Armatinol B (8): colorless oil; $[\alpha]^{25}_D$ −4.4° (*c* 0.6, $CHCl_3$); UV (MeOH) λ_{max} (log ϵ) 206 (3.9) nm; IR (KBr) ν_{max} 3385, 1735 cm^{-1}; ^1H NMR ($CDCl_3$, 300 MHz) δ 0.68 (3H, s, H_3-18), 0.94 (3H, d, J = 6.3 Hz, H_3-21), 1.02 (3H, d, J = 6.9 Hz, H_3-26), 1.03 (3H, d, J = 6.3 Hz, H_3-27), 1.12 (1H, m, H-14), 1.15 (1H, m, H-12*β*), 1.18 (1H, m, H-17), 1.19 (1H, m, H-22), 1.30 (1H, m, H-16), 1.43 (1H, m, H-9), 1.45 (1H, m, H-20), 1.49 (1H, m, H-1α), 1.51 (1H, m, H-11), 1.60 (1H, m, H-22), 1.70 (1H, m, H-4*β*), 1.89 (1H, m, H-8), 2.02 (1H, m, H-12*β*), 2.05 (1H, m, H-1*β*),2.07 (3H, s, OAc), 2.17 (1H, m, H-4α), 2.18 (1H, m, H-25), 3.54 (1H, br s, H-6), 4.10 (1H, m, H-3), 4.49 (1H, d, J = 12.6 Hz, H-19), 4.61 (1H, J = 12.6 Hz, H-19), 4.66 (1H, s, H-28), 4.72 (1H, s, H-28); ^{13}C NMR ($CDCl_3$, 75 MHz) δ 12.3 q (C-18), 18.7 q (C-21), 21.4 q (OAc), 21.9 q (C-26), 22.1 q (C-27), 22.3 t (C-11), 24.1 t (C-15), 25.5 t (C-1), 28.3 d (C-16), 31.7 d (C-8), 31.0 t (C-23), 32.1 t (C-2), 33.9 d (C-25), 34.1 t (C-7), 34.8 t (C-22), 35.8 d (C-20), 40.5 t (C-12), 41.2 t (C-4), 42.3 s (C-10), 42.9 s (C-13), 45.4 d (C-9), 56.1 d (C-17), 56.2 d (C-14), 64.6 d (C-19), 67.5 d (C-3), 75.1 s (C-5), 75.7 d (C-6), 106.0 t (C-28), 156.9 s (C-25), 171.7 s (OAc); EIMS *m*/*z* 490 $[M]^+$ (2), 472 (8), 430 (15), 198 (23), 69 (100); HREIMS *m*/*z* 490.3648 (calcd for $C_{30}H_{50}O_5$, 490.3645).

Cytotoxicity Testing. P-388 cells were kindly supplied by Dr. J. M. Pezzuto, University of Illinois at Chicago; A549 and HT-29 were purchased from the American Type Culture Collection. Cytotoxic assays were carried out according to a procedure described previously.[14] Mithramycin was used as the positive control and showed cytotoxicity against A-549, HT-29, and P-388 cells with IC_{50} values 0.2, 0.3, and 0.1 μM, respectively.

Acknowledgment. We thank Dr. J. M. Pezzuto for the provision of the P-388 cell line. This work was supported by grants from the National Science Council of Taiwan awarded to C.-Y.D.

Supporting Information Available: 2D INADEQUATE NMR spectrum of **1** and tables for HMBC and NOESY correlations of **1**−**6** are available free of charge via the Internet at http://pubs.acs.org.

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NP0400858