Constituents with a Novel Skeleton Isolated from *Amentotaxus formosana*

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A novel compound consisting of two diterpenoid substructures, amentotaxin BA (**1**), and two novel terpenoids with a new skeleton, amentotaxins WA (**2**) and WB (**3**), were isolated from the barks and heart woods of *Amentotaxus formosana*, respectively. Their structures, including the relative configuration, were elucidated from spectroscopic data and a computer-generated plot for the 3D structure.

1. Introduction. – *Amentotaxus formosana* LI (Amentotaxaceae) is a tree endemic to southeastern Taiwan. Recently, two new lanostanoids, isolated from the leaf of *Amentotaxus formosana*, have been reported [1]. As part of a continued search for novel bioactive constituents from this plant, a novel compound consisting of two diterpenoid substructures, amentotaxin BA (**1**), and two novel terpenoids with a new skeleton, amentotaxins WA (**2**) and WB (**3**), were isolated from the $CHCl_3$ extract of air-dried barks and heart woods of *A. formosana,* respectively. In the present paper, the structure elucidations of the novel compounds are reported.

2. Results and Discussion. – Amentotaxin BA (**1**), a colorless, optically active oil, revealed a M^+ at m/z 614.3975 in the high-resolution MS, which corresponds to the molecular formula $C_{40}H_{54}O_5$. The IR absorption of **1** implied the presence of an OH (3440 cm^{-1}) and two carbonyl groups (1713 and 1650 cm^{-1}), which were confirmed by ^{13}C-NMR data (off-resonance *s* at δ 213.4 and 221.5), and an aromatic ring (1620 cm^{-1}) moiety. The proposed structure for amentotaxin BA (**1**; see *Fig. 1*) was deduced from extensive analysis of the 1D and 2D NMR data, including those from COSY, HMQC, HMBC, and NOESY experiments in $CDCl_3$ (*Table 1*).

The ^{1}H- and ^{13}C-NMR spectra of **1** displayed signals of a moiety with three angular Me groups at δ(H) 0.80, 0.86, and 1.07, an sp^3 CH_2 group δ(H) 1.85 (*d*, $J = 12.6$ Hz, H_β–C(14)) and 2.41 (*d*, $J = 12.6$ Hz, H_α–(14)), an olefinic proton at δ(H) 6.65 (*d*, $J = 6.8$ Hz), and a carbonyl group at δ(C) 221.5, and were similar to those of *ent*-

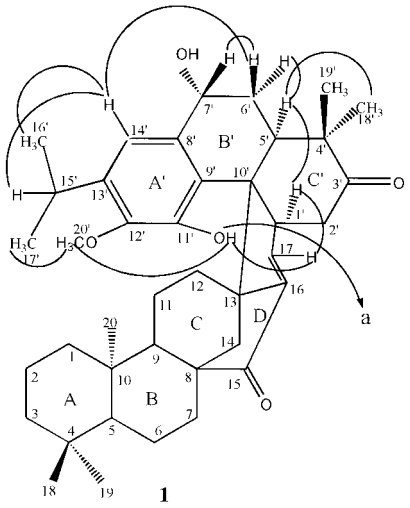

Fig. 1. *Structure of* **1** *including selected NOESY correlations, relative configuration, and major MS fragmentation pattern.* Arbitrary numbering.

kaur-16-en-15-one, except for the absence of signals of an exocyclic methylene and a cyclic skeletal methine group [2]. In addition to the above evidence, the ^{1}H- and ^{13}C-NMR data (*Table 1*) revealed signals due to a pentasubstituted benzene ring, an ^{i}Pr, two tertiary Me, a phenolic OH and a MeO group, and two sp^3 CH_2, two sp^3 CH, an OCH, a quarternary, and a carbonyl C-atom. The HMBC correlations Me(16′)/C(13′), C(15′), and C(17′), Me(17′)/C(13′) and C(15′), H–C(14′)/C(7′), C(8′), C(9′), and C(12′), and Me(20′)O/C(12′), and the NOESY cross-peak H–C(14′)/Me(16′) established the pentasubstituted benzene moiety. The COSY correlations H–C(7′)/CH_2(6′) and CH_2(6′)/H–C(5′), and the HMBC correlation C(7′)/H–C(14′) established the connection between C(5′) to C(8′). The HMBC correlation C(10′)/H_α–C(6′) and the C(10′) being a quarternary C-atom established that C(5′) was linked *via* C(10′) to C(9′). The COSY correlation H–C(1′)/CH_2(2′), the HMBC correlations C(3′)/H–C(1′), Me(19′)/C(3′), C(18′), and C(4′), Me(18′)/C(4′) and C(19′), and C(10′)/H_α–C(6′), and the C(10′) being a quarternary C-atom established the connectivity of ring C′. The HMBC correlations H–C(1′)/C(16) and C(17), and C(1′)/H–C(17), the COSY correlation H–C(1′)/H–C(17), and both the C(10′) and C(13) being quarternary C-atoms established the connection between C(10′) to C(13) and that of C(1′) to C(16) *via* C(17). In the EI-MS of **1** (*Fig. 1*), significant peaks at *m*/*z* 596 ($[M-H_2O]^+$), 330 ($[M-a]^+$), 310 ($[596-a-2H]^+$), and 270 ($[330-H_2O-CH(CH_3)_2+H]^+$) also supported the structure of **1**. The NOESY experiment of **1** showed cross-peaks as shown in the computer-generated 3D drawing . The relative configurations at C(1′), C(5′), and C(7′) were deduced from the NOESY cross-peaks H_α–C(6′)/H–C(5′), H–C(5′)/Me(18′), and H–C(1′)/H–C(5′), establishing that H–C(1′) and H–C(5′) are on the α-side. The NOESY cross-peak H_β–C(6′)/H–C(7′) suggested that OH–C(7′) adopted the α-configuration.

Based on the information from ^{1}H,^{1}H-COSY, and NOESY data of **1**, a computer-assisted 3D structure was obtained with the molecular-modeling program CS CHEM 3D V3.5.1, by means of a MM2 force-field calculation for energy minimization. The calculated distances between H_α–C(1′)/H–C(17) (2.651 Å), H_α–C(1′)/H_α–C(5′) (3.981 Å), H_α–C(5′)/H_α–C(6′) (2.309 Å), H_α–C(5′)/Me(18′) (2.418 Å), H_β–C(6′)/H_β–C(7′) (2.461 Å), H_β–C(7′)/H–C(14′) (2.275 Å), H–C(14′)/H–C(15′) (2.236 Å), H–C(14′)/Me(16′) (3.640 Å), Me(17′)/Me(12′)O (2.848 Å), Me(12′)O/OH–C(11′) (2.019 Å), and OH–C(11′)/H–C(17) (3.326 Å) are all less than 4.00 Å, which is

Table 1. *^{1}H- and ^{13}C-NMR Data* (δ in ppm, J in Hz) *of* **1** *in $CDCl_3$* [a]. Arbitary numbering (see *Fig. 1*).

	δ(H)	δ(C)	HMBC (^{1}H)		δ(H)	δ(C)	HMBC (^{1}H)
2 H−C(1)	1.70 (*m*)	39.3	1.07 (Me(20))	H−C(1′)	3.26 (*ddd*, *J* = 13.1, 13.1, 6.8)	53.2	6.65 (H−C(17))
2 H−C(2)	1.69 (*m*)	18.6		2 H−C(2′)	1.27 (*dd*, *J* = 13.1, 6.8)	29.7	
2 H−C(3)	1.35 (*m*), 1.09 (*m*)	41.8	0.86 (Me(19))	C(3′)		213.4	3.26 (H−C(1′)), 0.95 (Me(19′))
C(4)		33.2	0.80 (Me(18))	C(4′)		47.1	1.04 (Me(18′)), 0.95 (Me(19′))
H−C(5)	3.29 (*dd*, *J* = 13.1, 6.8)	55.2	1.07 (Me(20)), 0.86 (Me(19))	H−C(5′)	2.15 (br. *s*)	38.6	
2 H−C(6)	1.69 (*m*)	18.6		H_α−C(6′)	1.80 (*m*)	38.0	
2 H−C(7)	1.83 (*m*)	27.7		H_β−C(6′)	2.00 (*dd*, *J* = 13.4, 4.1)		
C(8)		52.2		H_β−C(7′)	4.87 (*dd*, *J* = 12.0, 4.1)	66.8	7.06 (H−C(14′))
H−C(9)	1.04 (*m*)	52.9	1.07 (Me(20))	C(8′)		138.0	7.06 (H−C(14′))
C(10)		39.8		C(9′)		117.1	7.06 (H−C(14′))
2 H−C(11)	1.32 (*m*)	18.3		C(10′)		46.4	6.65 (H−C(17)), 0.95 (Me(19′)), 1.80 (H_α−C(6′))
				C(11′)		146.4	
2 H−C(12)	2.15 (*m*)	34.7		OH−C(11′)	6.09 (*s*)		
C(13)		51.6		C(12′)		143.4	7.06 (H−C(14′)), 3.80 (Me(20′)O)
H_α−C(14)	2.41 (*d*, *J* = 12.6)	35.1		C(13′)		140.1	1.25 (Me(16′))
H_β−C(14)	1.85 (*m*)			H−C(14′)	7.06 (*s*)	114.4	
C(15)		221.5	2.41 (H_α−C(14))	H−C(15′)	3.26 (*m*)	26.8	1.25 (Me(16′))
C(16)		142.4	3.26 (H−C(1′))	Me(16′)	1.25 (*d*, *J* = 6.8)	23.5	
H−C(17)	6.65 (*d*, *J* = 6.8)	120.0	3.26 (H−C(1′))	Me(17′)	1.25 (*d*, *J* = 6.8)	23.8	1.25 (Me(16′))
Me(18)	0.80 (*s*)	21.5		Me(18′)	1.04 (*s*)	20.2	0.95 (Me(19′))
Me(19)	0.86 (*s*)	33.4	0.80 (Me(18))	Me(19′)	0.95 (*s*)	24.6	1.04 (Me(18′))
Me(20)	1.07 (*s*)	17.5		Me(20′)O	3.80 (*s*)	61.9	

[a]) All assignments were confirmed by HMQC, HMBC, and NOESY data.

consistent with the well-defined NOEs observed for each of these proton pairs (*Fig. 1*). Thus, the structure **1** for amentotaxin BA, with a configuration as shown in *Fig. 1*, was confirmed.

The molecular formula of amentotaxin WA (**2**; $C_{18}H_{20}O_3$) was established by HR-EI-MS (*m*/*z* 284.1409, M^+). The IR absorptions of **2** implied the presence of an OH (3171 cm^{-1}), a C=O (1720 cm^{-1}), and an α,β-unsaturated carbonyl group (1636 cm^{-1}), besides an aromatic ring (1600 cm^{-1}). The structure proposed for **2** (*Fig. 2*) was deduced from extensive analysis of 1D and 2D NMR data, including those from COSY, HMQC, HMBC, and NOESY experiments in $(CD_3)_2CO$ (*Table 2*).

The ^{1}H-NMR spectrum of **2** showed signals for two tertiary Me groups at δ 1.59 and 1.60, and a *cis*-disubstituted olefin moiety at δ 6.13 (*d*, *J* = 9.6 Hz, 1 H) and 7.68 (*d*, *J* = 9.6 Hz, 1 H), an aromatic proton at δ 7.32 (*s*), and a phenolic OH at δ 8.63 (br. *s*). The above evidence suggested that **2** contained a phenolic OH group at a disubstituted 1,1-dimethylnaphthalene-2(1*H*)-one moiety [3]. The ^{1}H-NMR spectrum of **2** also

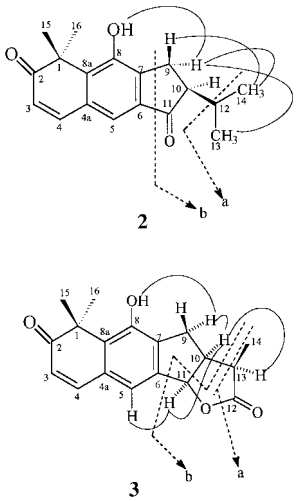

Fig. 2. *Structure of* **2** *and* **3**, *with major MS fragmentations and NOESY correlations.* Arbitrary numbering.

revealed signals for two secondary Me groups at δ 0.80 (*d*, $J = 6.8$ Hz) and 1.05 (*d*, $J = 6.8$ Hz), a CH_2 group at δ 2.94 (*dd*, $J = 17.6$, 3.6 Hz, 1 H) and 3.23 (*dd*, $J = 17.6$, 8.0 Hz, 1 H), and two CH protons at δ 2.31 (*m*) and 2.72 (*m*). The ^{13}C-NMR spectrum showed signals for four Me, a CH_2, and two CH groups and for two olefinic, a tertiary aromatic, and eight quarternary C-atoms. The HMBC correlations of H–C(5)/C(4), C(6), C(7), and C(11) (*Table 2*), and the NOESY cross-peak of OH–C(8)/H_α–C(9) (*Fig. 2*) confirmed the presence of a 6,7-disubstituted 8-hydroxy-1,1-dimethylnaphthalene-2(1*H*)-one moiety in **2**. The COSY correlations CH_2(9)/H–C(10), H–C(10)/H–C(12), H–C(12)/Me(13) and Me(14), and HMBC correlations (*Table 2*) established the 2-isopropylcyclopentan-1-one moiety. The EI-MS of **2** showed significant peaks at *m*/*z* 242 ($[M - a + H]^+$), 214 ($[242 - CO]^+$), and 181 ($[M - b - 2\,H]^+$) which also supported the structure of **2**.

The molecular formula of amentotaxin WB (**3**; $C_{18}H_{18}O_4$) was established by HR-EI-MS (*m*/*z* 298.1209, M^+). The IR absorptions of **3** implied the presence of an OH group (3244 cm^{-1}), a γ-lactone ring (1743 cm^{-1}), an α,β-unsaturated carbonyl group (1652 cm^{-1}), and an aromatic ring (1562 cm^{-1}). The proposed structure of **3** (*Fig. 2*) was deduced from extensive analysis of 1D and 2D NMR data, including those from COSY, HMQC, HMBC, and NOESY experiments in $(CD_3)_2CO$ (*Table 2*).

The ^{1}H-NMR spectrum of **3** showed signals for two tertiary Me groups at δ 1.54 and 1.55, and a *cis*-disubstituted olefin moiety at δ 6.07 (*d*, $J = 9.6$ Hz, 1 H) and 7.60 (*d*, $J = 9.6$ Hz, 1 H), an aromatic proton at δ 7.18 (*s*), and a phenolic OH at δ 8.36 (br. *s*). The above evidence suggested that also **3** contained a phenolic OH group at a disubstituted 1,1-dimethylnaphthalene-2(1*H*)-one moiety [3]. The ^{1}H-NMR spectrum of **3** also revealed signals for a secondary Me group at δ 1.25 (*d*, $J = 7.2$ Hz), a CH_2 group at δ 2.87 (*dd*, $J = 17.2$, 4.8 Hz, 1 H) and 3.16 (*dd*, $J = 17.2$, 8.8 Hz, 1 H), three CH groups at δ 3.13 (*m*), 3.47 (*m*), and 5.67 (*d*, $J = 6.0$ Hz). The ^{13}C-NMR spectrum showed signals for three Me, a CH_2, and three CH groups and for two olefinic, a tertiary aromatic, and eight quarternary C-atoms. The HMBC correlations H–C(5)/C(4), C(7), and C(8a) (*Table 2*), and the NOESY cross-peak OH–C(8)/H_α–C(9) (*Fig. 2*) confirmed the presence of a 6,7-disubstituted 8-hydroxy-1,1-dimethylnaphthalene-2(1*H*)-one moiety in **3**. The COSY correlations CH_2(9)/H–C(10), H–C(10)/H–C(11) and H–C(13), and H–C(13)/Me(14) confirmed the connectivities between C(9) to C(11), C(10) to C(13), and C(13) to C(14). The HMBC correlations H_β–C(9)/C(6), C(7), and C(8), and H_α–C(9)/C(7) established the connectivity between C(7) and C(9). The HMBC correlations Me(14)/C(13) and C(12) established the connectivity between C(12) and C(13). The HMBC correlations H–C(5)/C(11) and H–C(11)/C(7), and NOESY cross-peak H–C(5)/H–C(11) established the connectivity between C(6) and C(11). In addition to the above HMQC, COSY, and HMBC correlations, the ^{13}C-NMR spectrum of **3** revealed a

Table 2. *^{1}H- and ^{13}C-NMR Data* (δ in ppm, J in Hz) *of* **2** *and* **3** *in (D$_6$)Acetone.* Arbitary numbering (see *Fig. 2*).

	2			**3**		
	δ(H)	δ(C)	HMBC (^{1}H)	δ(H)	δ(C)	HMBC (^{1}H)
C(1)		47.5	6.13 (H–C(3)), 1.60 (Me(15)), 1.60 (Me(16))		47.1	6.07 (H–C(3)), 1.54 (Me(15)), 1.54 (Me(16))
C(2)		203.7	7.68 (H–C(4)), 1.60 (Me(15)), 1.60 (Me(16))		204.3	7.60 (H–C(4)), 1.54 (Me(15)) 1.54 (Me(16))
H–C(3)	6.13 (*d*, *J* = 9.6)	125.1		6.07 (*d*, *J* = 9.6)	124.3	
H–C(4)	7.68 (*d*, *J* = 9.6)	146.2	7.32 (H–C(5))	7.60 (*d*, *J* = 9.6)	146.5	7.18 (H–C(5))
C(4a)		135.1	6.13 (H–C(3)), 7.68 (H–C(4))		131.2	6.07 (H–C(3))
H–C(5)	7.32 (*s*)	117.1	7.68 (H–C(4))	7.18 (*s*)	120.7	7.60 (H–C(4))
C(6)		143.7	7.32 (H–C(5))		140.6	3.16 (H$_\beta$–C(9))
C(7)		138.2	7.32 (H–C(5))		134.4	7.18 (H–C(5)), 2.87 (H$_\alpha$–C(9)), 3.16 (H$_\beta$–C(9)), 5.67 (H$_\alpha$–C(11))
C(8)		153.9			152.8	3.16 (H$_\beta$–C(9))
HO–C(8)	8.63 (br. *s*)			8.36 (br. *s*)		
C(8a)		138.5	7.68 (H–C(4)), 1.60 (Me(15)), 1.60 (Me(16))		135.0	7.60 (H–C(4)), 7.18 (H–C(5)), 1.54 (Me(15)), 1.54 (Me(16))
H$_\alpha$–C(9)	2.94 (*dd*, *J* = 17.6, 8.0)	26.1	2.72 (H$_\alpha$–C(10))	2.87 (*dd*, *J* = 17.2, 4.8)	29.7	
H$_\beta$–C(9)	3.23 (*dd*, *J* = 17.6, 3.6)			3.16 (*dd*, *J* = 17.2, 8.8)		
H$_\alpha$–C(10)	2.72 (*m*)	53.8	2.94 (H$_\alpha$–C(9)), 3.23 (H$_\beta$–C(9)), 0.80 (Me(13)), 1.05 (Me(14))	3.47 (*m*)	44.3	1.25 (Me(14))
C(11)		207.4	7.32 (H–C(5)), 3.23 (H$_\beta$–C(9))			
H$_\alpha$–C(11)				5.67 (*d*, *J* = 6.0)	85.8	3.16 (H$_\beta$–(9)), 7.18 (H–C(5)), 3.13 H$_\alpha$–C(13))
H–C(12)	2.31 (*m*)	29.6	2.94 (H$_\alpha$–C(9)), 0.80 (Me (13)), 1.05 (Me(14))			
C(12)					178.8	3.47 (H$_\alpha$–C(10)), 1.25 (Me(14))
Me(13)	0.80 (*d*, *J* = 6.8)	17.9	1.05 (Me(14))			
H$_\alpha$–C(13)				3.13 (*m*)	38.8	2.87 (H$_\alpha$–C(9)), 1.25 (Me(14))
Me(14)	1.05 (*d*, *J* = 6.8)	20.8	0.80 (Me(13))	1.25 (*d*, *J* = 7.2)	12.1	
Me(15)	1.60 (*s*)	24.1	1.59 (Me(16))	1.55 (*s*)	24.4	1.54 (Me(16))
Me(16)	1.59 (*s*)	24.1	1.60 (Me(15))	1.54 (*s*)	24.2	1.54 (Me(15))

tertiary O-substituted C-atom at δ 85.8 and a quarternary C-atom at δ 178.8, and its IR spectrum indicated the presence of a γ-lactone ring. The EI-MS spectrum of **3** showed significant peaks at m/z 283 ($[M - \text{Me}]^+$), 255 ($[283 - \text{CO}]^+$), 240 ($[M - \text{a} - 2\text{ H}]^+$), and 211 ($[M - \text{b} - 2\text{ H}]^+$) in accordance with the proposed structure. The relative configurations at C(10), C(11), and C(13) were deduced from the NOESY cross-peaks H–C(10)/H$_\alpha$–C(9), H–C(11), and H–C(13), establishing that H–C(10), H–C(11), and H–C(13) are on the α-side (*Fig. 2*).

The uncommon structure of amentotaxin BA (**1**) results from the spiro-annulation of an abietane-type diterpene and a kaurane-type diterpene. The terpenoid **3** can be biologically derived from **2** by lactonization of OH−C(11) and COOH−C(12), the latter being formed in **2** by reduction at C(11) and oxidation at C(13).

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Experimental Part

General. M.p.: uncorrected. Optical rotations: *Jasco DIP-370* digital polarimeter. UV Spectra: *Jasco* UV/VIS spectrophotometer; λ_{max} (log ε) in nm. IR Spectra: *Perkin Elmer 200* FT-IR spectrophotometer; ν in cm^{-1}. ^1H- and ^{13}C-NMR Spectra: *Varian Unity-400* spectrometer; at 400 and 100 MHz, resp.; δ in ppm, J in Hz. MS: *JMSHX100*-mass spectrometer; m/z (rel. %).

Plant Material. Whole plants of *A. formosana* were collected at Kaohsiung Hsien, Taiwan, R.O.C., during July 1990, and a voucher specimen (9001) has been deposited at the Department of Medical Chemistry, School of Pharmacy, Kaohsiung Medical University.

Extraction and Isolation. $CHCl_3$ extract (15.7 g) of air-dried barks (0.7 kg) of *A. formosana* was chromatographed over silica gel. Elution with CH_2Cl_2/Me_2CO 50:1 yielded **1** (5 mg). The $CHCl_3$ extract (6.5 g) of the heart woods (1.6 kg) of *A. formosana* was chromatographed over silica gel. Elution with hexane/acetone 1:0 → 0:1, gave a 1st fraction with hexane/acetone 6:1, which was purified by column chromatography (silica gel, CH_2Cl_2) to afford **2** (8 mg), and a 2nd fraction with hexane/acetone 3:1, which was also purified by column chromatography (silica gel, hexane/AcOEt 3:4) to afford **3** (15 mg).

Amentotaxin BA (= *3′,4′-Dihydro-7″α,11″-dihydroxy-12″-methoxy-13*H-*abieta-8″,11″,13″-trien[10″,1″:3′,4′]cyclopenta[2′,1′:13,16]ent-17-norkaur-13(16)-ene-3″,15-dione* = *1,2,2a,3,5,5a,9,9a,10,11,12,13,13a,13b,14,15-hexadecahydro-1,16-dihydroxy-18-isopropyl-17-methoxy-3,3,10,10,13a-pentamethyl-8*H-*7a,15a-methano-[2′,1′:5,6]azuleno[2,1-*a*]phenanthrene-4,7-dione*; **1**): Colorless oil. $[\alpha]_D^{25} = -36$ ($c = 0.20$, $CHCl_3$). IR (KBr): 3440, 1713, 1650. ^1H-NMR ($CDCl_3$, 400 MHz): *Table 1*. ^{13}C-NMR ($CDCl_3$, 100 MHz): *Table 1*. EI-MS (70 eV): 614 (22), 596 (1), 330 (0.3), 310 (16), 270 (66). HR-EI-MS: 614.3975 ($C_{40}H_{54}O_5^+$; calc. 614.3971).

Amentotaxin WA (= *(2*R*)- or (2*S*)-2,3-Dihydro-4-hydroxy-2-isopropyl-5,5-dimethyl-1*H-*cyclopenta[*b*]-naphthalen-1,6(5*H*)-dione*; **2**): White powder from $CHCl_3$. $[\alpha]_D^{25} = -2.4$ ($c = 0.1$, acetone). UV (MeOH): 219 (4.19), 238 (3.83), 270 (4.32), 307 (3.93), 350 (sh, 3.54). IR (KBr): 3171, 1720, 1636,1600. ^1H-NMR (400 MHz, $(CD_3)_2CO$): *Table 2*. ^{13}C-NMR (100 MHz, $(CD_3)_2CO$): *Table 2*. EI-MS (70 eV): 284(2), 242(19), 241 (2) 227(11), 214(33), 199(17), 172(12), 185(7), 181(5), 141(36), 128(14), 115(62), 55(100). HR-EI-MS: 284.1409 ($C_{18}H_{20}O_3^+$; calc. 284.1412).

Amentotaxin WB (= rel-*(3*R*,3a*S*,10b*R*)-3a,4,6,10b-Tetrahydro-5-hydroxy-3,6,6-trimethyl-2*H-*benzo[5,6]indeno[1,2-*b*]furan-2,7(3*H*)-dione*; **3**): White powder from hexane/acetone. $[\alpha]_D^{25} = -48.4$ ($c = 0.1$, acetone). UV (MeOH): 212 (4.13), 225 (4.24), 312 (4.74). IR (KBr): 3244, 1743, 1652 ,1562. ^1H-NMR (400 MHz, $(CD_3)_2CO$): *Table 2*. ^{13}C-NMR (100 MHz, $(CD_3)_2CO$): *Table 2*. EI-MS (70 eV): 298(6), 283(3), 270(7), 255 (3), 240 (1), 239(6), 226(17), 211(61), 197(26), 181(40), 172(35), 165(52), 141(44), 128(73), 115(87), 91(51), 55(100). HR-EI-MS: 298.1209 ($C_{18}H_{18}O_4^+$; calc. 298.1205).

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