

Table 1. ^1H NMR (CD_3OD , 500 MHz) and ^{13}C NMR Data (CD_3OD , 50 MHz) of **2**

Position	δ_{H} (mult, J)	δ_{C}	HMBC (H to C)
1	3.72 (dd, 9.5, 3.5)	73.2	2, 3, 1'
	3.53 (dd, 9.5, 6.0)		
2	3.91 (m)	70.9	1, 3, 1'
3	3.47 (dd, 10.0, 5.0)	73.1	2, 3, 1"
	3.43 (dd, 10.0, 6.0)		
1'	3.53 (t, 7.0)	84.4	1, 2', 3', 5'
2'	3.82 (t, 5.5)	75.1	1, 1', 3'
3'	3.72 (t, 6.0)	81.9	2', 4'
4'	3.54 (t, 7.0)	81.6	3', 5'
5'	3.82 (t, 6.0)	80.0	1, 1', 4'
1"	3.45 (t, 8.0)	72.7	2, 3, 2", 3"
2"	1.56 (quint, 7.0)	30.3-30.8	1", 3"
3"	1.28-1.34 (m)	27.2	
4"-7"	1.28-1.34 (m)	30.3-30.8	
8"	1.28-1.34 (m)	30.3-30.8	
9"	1.28-1.34 (m)	30.3-30.8	
10"	2.02 (m)	28.1	9", 11", 14"
11"	5.34 (t, 5.5)	130.8	10"
12"	5.34 (t, 5.5)	130.8	13"
13"	2.02 (m)	27.9	9", 11", 12"
14"	1.28-1.34 (m)	33.1	13", 15"
15"	1.28-1.34 (m)	23.4	14", 16"
16"	0.90 (t, 7.0)	14.3	14", 15"

7.0 Hz) and a triplet (δ 5.34, J = 5.5 Hz), respectively. The chemical shifts of the allylic carbons (δ 28.1 and δ 27.9) indicated that the double bond geometry is *cis*.⁵ The chemical shifts of H-2 and C-2 (δ 3.91, 70.9) indicated that the cyclitol and the alkyl chain were ether linked to the glycerol at C-1 and C-3, respectively. The double bond position in **2** was clearly recognized from the FAB-CID tandem mass spectrum of the $[\text{M}+\text{Na}]^+$ ion (Figure 1). Major fragmentations of the $[\text{M}+\text{Na}]^+$ ion were observed as odd mass ions due to the remote charge fragmentation which is characteristic of the collisional activation of alkali-metal-cationized ion. The location of the double bond was clear from the 54-mass gap between the major fragment ions of allylic cleavage at m/z 425 and 371.⁴

The relative stereochemistry of the five-membered cyclitol moiety of **2** was presumed to be identical to **1** based on the comparison of NMR spectral data.

Sarcotride C (**3**) was isolated as a light yellow oil. FABMS of **3** showed the $[\text{M}+\text{H}]^+$ ion at m/z 449 accompanied by the $[\text{M}+\text{Na}]^+$ ion at m/z 471. As indicated by the ^1H and ^{13}C NMR data, **3** was a dihydro analog of **2**. The relative stereochemistry of the five-membered cyclitol moiety and the C-2 of glycerol moiety was presumed to be identical to **1** based on the NMR data.

Compounds **1-3** showed moderate to significant cytotoxicity against a small panel of five human tumor cell lines (Table 2). Sarcotride A (**1**) inhibited DNA replication *in vitro* at the level of initiation.⁴ A couple of biological activities such as antifeedant activity⁶ and nerve growth factor stimu-

Table 2. Cytotoxicity of Compounds **1-3** against Human Solid Tumor Cells^a

Compound	A549	SK-OV-3	SK-MEL-2	XF498	HCT15
1 ^b	>10	9.5	>10	9.8	9.4
2	11.5	5.1	7.9	7.5	10.5
3	4.8	5.3	4.6	4.3	5.3
doxorubicin	0.02	0.16	0.02	0.13	0.06

^aData expressed in ED_{50} values ($\mu\text{g}/\text{mL}$). A549, human lung cancer; SK-OV-3, human ovarian cancer; SK-MEL-2, human skin cancer; XF498, human CNS cancer; HCT 15, human colon cancer. ^bData from the reference 4.

latory activity⁷ were attributed to this class of compounds.

Compounds analogous to **1-3** appear to be widely distributed in various sponges. They were reported from Caribbean sponges *Pseudoceratina crassa*,⁶ *Verongula gigantea*, *Aplysina fistularis fulva*, *Aplysina cauliformis*, *Neofibularia nolintangere*,⁸ Okinawan sponges *Luffariella* sp., *Biemna* sp., *Xestopongia* sp.,⁷ and a Korean sponge *Petrosia* sp.⁴ They might be ubiquitous metabolites of sponges and play some significant role in the life of the organisms.

Experimental Section

General Experimental Procedures. Optical rotations were obtained using a JASCO DIP-1000 digital polarimeter. ^1H and ^{13}C NMR spectra were recorded on a Varian Inova 500 and Bruker AC200. Chemical shifts were reported with reference to the respective residual solvent peaks (δ_{H} 3.30 and δ_{C} 49.0 for CD_3OD). FABMS data were obtained on a JEOL JMS-700 double focusing (B/E configuration) instrument. HPLC was performed with an YMC ODS-H80 (semipreparative, 250×10 mm i.d., $4 \mu\text{m}$, 80 \AA ; preparative, 250×20 mm i.d., $4 \mu\text{m}$, 80 \AA) column using a Shodex RI-71 detector.

Animal Material. The sponge was collected in July 1998 (15-25 m depth), off Cheju Island, Korea. This specimen was identified as *Sarcotragus* sp. by Prof. Chung Ja Sim, Hannam University. A voucher specimen (J98J-5) of the sponge (registry No. Por. 33) was deposited in the Natural History Museum, Hannam University, Daejeon, Korea, and has been described elsewhere.²

Isolation. The frozen sponge (7 kg) was extracted with MeOH at room temp. The MeOH extract of the sponge displayed cytotoxicities against five human tumor cell lines (A549, SK-OV-3, SK-MEL-2, XF498, HCT15), the ED_{50} values ($\mu\text{g}/\text{mL}$) were 19.0, 20.3, 11.8, 15.5, and 12.6, respectively. The MeOH extract was partitioned between water and CH_2Cl_2 . The CH_2Cl_2 soluble was further partitioned between 90% methanol and *n*-hexane to yield 90% methanol (54 g) and *n*-hexane soluble (13 g) fractions. The 90% methanol fraction was subjected to a reversed-phase flash column chromatography (YMC Gel ODS-A, 60 \AA 500/400 mesh), eluting with a solvent system of 25 \rightarrow 0% $\text{H}_2\text{O}/\text{MeOH}$, to obtain twenty fractions (Fg1-Fg20). These fractions were evaluated for activity in the brine shrimp assay, and fractions Fg6-Fg9 were found active. Compound **1** (5.3 mg), **2** (4.7

mg), and **3** (1.2 mg) were obtained by purification of fraction Fg 6-8, Fg 6-5, and Fg 10-6, respectively, by ODS HPLC.

Sarcotride A (1): light yellow oil; $[\alpha]_{\text{D}}^{21}$ -6° , (*c* 0.15, MeOH); FABMS *m/z* 485 $[\text{M}+\text{Na}]^+$ (100), 295 (2), 245 (3), 322 (15), 136 (5); HRFABMS *m/z* 485.3436 (calcd for $\text{C}_{25}\text{H}_{50}\text{O}_7\text{Na}$, 485.3454).

Sarcotride B (2): light yellow oil; $[\alpha]_{\text{D}}^{21}$ $+24^\circ$, (*c* 0.14, MeOH) ^1H and ^{13}C NMR data, see Table 1; FABMS *m/z* 469 $[\text{M}+\text{H}]^+$ (79), 455 (8), 371 (3), 322 (15), 245 (6), 171 (69), 164 (23), 155 (7), 132 (71), 95 (1); HRFABMS *m/z* 469.3137 (calcd for $\text{C}_{24}\text{H}_{46}\text{O}_7\text{Na}$, 469.3141).

Sarcotride C (3): light yellow oil; $[\alpha]_{\text{D}}^{21}$ $+10^\circ$, (*c* 0.04, MeOH); ^1H NMR (500 MHz, CD_3OD) δ 3.72 (1H, dd, *J* = 9.5, 3.5 Hz, H-1a), 3.53 (1H, dd, *J* = 9.5, 6.0 Hz, H-1b), 3.91 (1H, m, H-2), 3.47 (1H, dd, *J* = 10.0, 5.0 Hz, H-3a), 3.43 (1H, dd, *J* = 10.0, 6.0 Hz, H-3b), 3.53 (1H, t, *J* = 7.0 Hz, H-1'), 3.82 (1H, t, *J* = 5.5 Hz, H-2'), 3.72 (1H, t, *J* = 6.0 Hz, H-3'), 3.54 (1H, t, *J* = 7.0 Hz, H-4'), 3.82 (1H, t, *J* = 6.0 Hz, H-5'), 3.45 (2H, t, *J* = 8.0 Hz, H-1''), 1.56 (2H, quint, *J* = 7.0 Hz, H-2''), 1.26-1.36 (20H, m, H-3''-H-15''), 0.90 (3H, t, *J* = 7.0 Hz, H-16''); ^{13}C NMR (50 MHz, CD_3OD) δ 73.3 (C-1), 70.9 (C-2), 73.1 (C-3), 84.5 (C-1'), 75.1 (C-2'), 82.0 (C-3'), 81.6 (C-4'), 80.0 (C-5'), 72.7 (C-1''), 30.5-30.8 (C-2'', C-4''-13''), 27.2 (C-3''), 33.1 (C-14''), 23.7 (C-15''), 14.4 (C-16'');

FABMS *m/z* 471 $[\text{M}+\text{Na}]^+$ (100), 449 $[\text{M}+\text{H}]^+$ (20), 307 (5), 135 (12).

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