evapd *in vacuo* to leave a solid residue (994 mg). The coupled product (**5**) was crystallized from EtOH as needles, mp 185°, $[\alpha]_D^{25°}$ −39.7° (*c* 0.99, Py); IR (KBr) ν_{max} 3340 (N—H), 1740 (O—CO), 1702 (O—CO—N), 1645 (N—CO) cm^{-1}; UV λ_{max}^{MeOH} 236 nm (*sh*, ε 8.54 × 10^3) and 211 nm (ε 1.61 × 10^4); CD (MeOH) $[\theta]_{230}$ −11530; ^{1}H NMR ($CDCl_3$) δ 2.70–3.16 (*m*, 4H), 3.90–4.76 (*m*, 4H), 4.99 (*s*, 2H), 6.5 (*br s*, 2H), 7.06–7.83 (*m*, 20 Ar-H); ^{13}C NMR ($CDCl_3$) δ 37.3 (*t*), 37.9 (*t*), 50.2 (*d*), 55.4 (*d*), 65.4 (*t*), 67.2 (*t*), four signals at 127.1, 128.6, 128.7 and 129.2 representing 18 Ar-C, 131.5 (*s*), 134.3 (*s*), 135.6 (*s*), 136 (*s*), 137 (*s*), 155.9 (*s*), 167.2 (*s*), 172.1 (*s*). Analysis: found C, 73.85%; H, 6.09%; N, 5.03%; calculated for $C_{33}H_{32}N_2O_5$: C, 73.86%; H, 6.01%; N, 5.22%.

(S)-N-*Benzoylphenylalanine*-(S)-*2-benzamido-3-phenyl propyl ester* (*asperphenamate*) (**1**). To a suspension of 20 mg carbobenzoxy-L-phenylalanyl-*N*-benzoyl-L-phenyl alaninol (**5**) in 10 ml of 80% HOAc was added 20 mg of 5% Pd/$BaSO_4$. The suspension was shaken with hydrogen in a Parr hydrogenator under 1 kg/cm^2 pressure for 24 hr. The catalyst was removed by filtration through Celite 545 and the reddish brown filtrate was evapd *in vacuo* to leave 45 mg dark brown residue. Purification by PLC (10% MeOH–$CHCl_3$) yielded 14 mg of the deprotected ester [IR ν_{max}^{KBr} 3320 (N—H), 1740 (O—CO), 1640 (N—CO) cm^{-1}]. A soln of 14 mg of the deprotected product in $CHCl_3$ (3 ml) was treated at room temp. with 0.01 ml PhCOCl followed by 0.5 ml NEt_3. After 30 min it was evapd *in vacuo* and the residue was purified by PLC (Brinkmann Sil G-50, 0.5 mm thickness, 4% MeOH–$CHCl_3$). Crystallization from EtOH yielded asperphenamate (**1**) (2 mg) as needles, mp 201–204°. The synthetic product was identical in all respects with the natural product (mp, mmp, TLC, co-TLC, IR, CD) obtained from the fungus.

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(+)-α(S)-BUTYRAMIDO-γ-BUTYROLACTONE FROM *LYNGBYA MAJUSCULA*

FRANZ-JOSEF MARNER and RICHARD E. MOORE
Department of Chemistry, University of Hawaii, Honolulu, HI96822, U.S.A.

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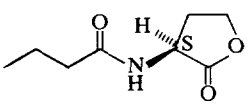
Key Word Index—*Lyngbya majuscula*; Oscillatoriaceae; (+)-α(S)-butyramido-γ-butyrolactone.

Abstract—(+)-α(S)-Butyramido-γ-butyrolactone is a minor constituent of the toxic marine blue–green alga *Lyngbya majuscula*.

Lyngbya majuscula is a toxic marine cyanophyte that is responsible for occasional outbreaks of a contact dermatitis known as 'swimmers' itch'. The toxin associated with the dermatitis-producing strain is debromoaplysiatoxin [1], but whether this compound actually causes the dermatitis is not known for certain. The toxin associated with the non-dermatitis-producing variety is a different substance [2]. In an investigation of this latter toxin, we have isolated a minor constituent of the alga and have identified it as (+)-α(*S*)-butyramido-γ-butyrolactone (**1**).



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The lactone was found in the gel filtration fraction that was eluted immediately after the toxin. Its structure was determined in a straightforward manner from spectral data (see Experimental) and confirmed by by acid hydrolysis to *n*-butyric acid and α-amino-γ-butyrolactone and synthesis from (−)-α(*S*)-amino-γ-butyrolactone and butyryl chloride.

EXPERIMENTAL

PMR and C^{13}NMR spectra were obtained using a 100 MHz spectrometer equipped with a Fourier transform system. Single frequency off-resonance decoupled C^{13}NMR spectra were determined with the proton decoupler at δ 14. Chemical shifts are reported in δ units (ppm) relative to TMS (δ = 0) as an int. stand All chromatographic separations were continuously assayed for UV absorption at 254 and 280 nm and all fractions were tested for toxicity in mice by intraperitoneal injection.

Isolation. Lyngbya majuscula was collected at Kahala Beach, Oahu in July 1976. The freeze-dried alga (680 g) was extracted twice with $CHCl_3$ and twice with MeOH to give 37 g of a dark brown oil. The extract (34 g) was chromatographed on a column of Si gel (550 g) using a hexane–$CHCl_3$–Me_2CO–

MeOH gradient and 500 ml fractions were collected. The toxic fractions (25 and 26, 712 mg total) eluted with $CHCl_3$–Me_2CO (4:1) were combined and further separated by gel filtration on a 110 × 2 cm column of Sephadex LH-20 with $CHCl_3$–MeOH (1:1). The solid (52 mg) eluted after the toxic oil was dissolved in CH_2Cl_2–hexane and 13 mg of (+)-α(*S*)-butyramido-γ-butyrolactone crystallized from the cooled soln as fine white needles, mp 120–121°; $[\alpha]_D^{25}$ = +18.9° ($CHCl_3$, *c* 0.74); PMR (1:1 $CDCl_3/C_6D_6$) δ 0.80 (*t*, *J* = 7 Hz, Me), 1.52 (*m*, *J* = 7 Hz, CH_2=Me), 1.92 (*t*, *J* = 7 Hz, CH_2=C=O), 1.92 (*m*, C-3 H), 2.13 (*dddd*, *J* = 2, 6, 9 and 12 Hz, C-3 H), 3.56 (*ddd*, *J* = 6, 9 and 12 Hz, C-4 H), 3.82 (*ddd*, *J* = 2, 9 and 9 Hz, C-4 H), 4.26 (*ddd*, *J* = 6, 9 and 12 Hz, C-2 H), 6.1 (*bd*, *J* = 6 Hz, NH); C^{13} NMR ($CDCl_3$) δ 13.6 (Me), 18.8 (CH_2), 30.3 (CH_2), 37.9 (CH_2), 49.0 (CH_2), 66.0 (CH), 173.4 (C=O), 175.4 (C=O); IR ($CHCl_3$) ν_{max} 3425, 2920, 2870, 1780, 1676 cm^{-1}; MS *m/e* (rel. intensity) 171 (11), 153 (7), 143 (73), 71 (88), 43 (100), 28 (95); high resolution mass measurement 171.088690 (calcd for $C_8H_{13}NO_3$ 171.089547).

Hydrolysis The natural (+)-α(*S*)-butyramido-γ-butyrolactone (10 mg) in 2N HCl was refluxed for several hr. The odor of *n*-butyric acid was detected. Evapn. of the solvent gave α-amino-γ-butyrolactone HCl which exhibited a PMR spectrum in D_2O that was identical to that of a commercial sample of α-amino-γ-butyrolactone hydrobromide. No optical rotation, however, could be detected.

Synthesis. Racemic α-butyramido-γ-butyrolactone prepared from α-amino-γ-butyrolactone hydrobromide following the procedure of ref. [3] melted at 83°. (+)-α(*S*)-Butyramido-γ-butyrolactone prepared from (−)-α(*S*)-amino-γ-butyrolactone hydrobromide [4] had mp 120–121° and $[\alpha]_D^{25}$ +21.1° ($CHCl_3$, *c* 0.18).

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SPHINGOSINE DERIVATIVES FROM RED ALGAE OF THE CERAMIALES

JOHN H. CARDELLINA and RICHARD E. MOORE
Department of Chemistry, University of Hawaii, Honolulu, HI 96822, U.S.A

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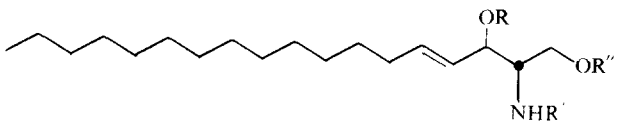
Key Word Index—*Laurencia nidifica*; *Amansia glomerata*, Rhodomelaceae; dihydrosphingosine *N,O*-diacetate; *N*-acylsphingosines.

Abstract—(+)-2(*S*)-*N*-Acetamido-3(*R*)-acetoxyoctadecan-1-ol, a diacetate of dihydrosphingosine, and fatty acid amides of (−)-2(*S*)-amino-3(*R*)-hydroxyoctadec-4(*E*)-en-1-ol (sphingosine) have been isolated from extracts of Hawaiian *Laurencia nidifica* and *Amansia glomerata*, respectively. Although well known as constituents of nerve tissue hydrolyzates throughout the animal kingdom, these compounds have not been previously found in plants.

INTRODUCTION

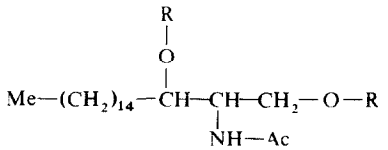
Sphingosine (**1a**) has been known since 1882 [1] to be a component of brain tissue hydrolyzate but its structure was not established until 65 years later [2]. This unsaturated amino dialcohol has been found in the hydrolyzates of rat, beef and human brain tissues In 1941, Lesuk and Anderson [3] isolated dihydrosphingosine (**2a**) from hydrolyzed larvae (*Cysticercus fasciolaris*) of *Taenia taeniaformis*, the common tapeworm of cats. Dihydrospingosine compounds were later [4] shown to be present in beef spinal cords.



1a R = R′ = R″ = H
1b R = R″ = H, R′ = $COCH_2(CH_2)_nMe$ where *n* = 12, 14, 16, 20, 21, 22

RESULTS AND DISCUSSION

While examining the more polar extracts of *Laurencia nidifica*, we isolated (+)-2(*S*)-*N*-acetamido-3(*R*)-acetoxyoctadecan-1-ol (**2b**), a diacetate of dihydrosphingosine. The IR spectrum provided evidence for alcohol, ester, and amide functionalities and the PMR spectrum indicated that these 3 groups were at one end of an aliphatic chain. Spin–spin decoupling experiments suggested partial structure *A*. The PMR spectrum of the triacetate derivative indicated a paramagnetic shift of a two proton multiplet (3.58 in **2b** → *ca* 4.2 in **2c**), fixing the position of the OH group as shown in **2b**.



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