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New Rearranged Neo-clerodane Diterpenoids from *Teucrium alyssifolium*

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Abstract: Four new diterpenoids alysine A, alysine B, 3-deacetylalysine B and alysine C with a novel rearranged neo-clerodane skeleton were isolated from *Teucrim alyssifolium*. The relative structures were determined by X-ray analysis and other spectroscopic methods including 1D and 2D NMR experiments (APT, SINEPT, HETCOR and HMBC).

INTRODUCTION

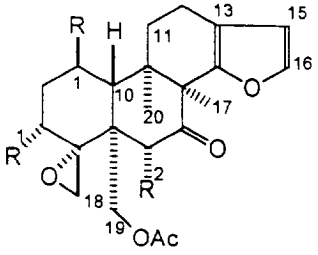
The chemical investigation of *Teucrium* species led to a remarkable interest on furanoditerpenoids with neo-clerodane skeleton in the last decade. Since *Teucrium* genus is the richest source of neo-clerodane diterpenoids[1-4] showing insect antifeedant activity and modest antitumor activity we aimed to study genus *Teucrium* grown in Turkey which is represented by 26 species. In a recent study, we have isolated a neo-clerodane diterpenoid along with a group of rearranged abietane diterpenoids from *T. divaricatum* subsp. *villosum*[5], the same type of rearranged abietanes was also found in *T. fruticans*[6,7].

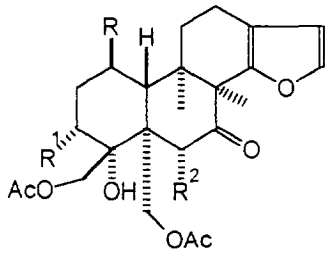
In the present study of the aerial parts of *T. alyssifolium* Stapf. an endemic plant to Turkey, four diterpenoids with an α,β disubstituted furan ring were obtained for the first time from nature representing a new rearranged neo-clerodane skeleton.

Air dried plant material was extracted with acetone at room temperature, evaporated under vacuum and subjected to column chromatography over silica gel. After rough separation, the combined fractions were further separated on small Si gel and/or Sephadex LH-20 columns. Final cleaning of the single compounds was performed on preparative TLC plates. Four new compounds alysine A (1), alysine B (2), 3-deacetylalysine B (3) and alysine C (4) were isolated.

RESULTS AND DISCUSSION

Alysine A (1). Obtained as colorless crystals, it has a molecular formula $C_{24}H_{30}O_9$ as determined by HR EIMS (*m/z* 462.1884). The structure was established based on particularly ^1H and ^{13}C NMR spectroscopic techniques including spin decoupling, HETCOR, HMBC and SINEPT experiments and confirmed by X-ray analysis.





1 R=R^2=OH, R^1=OAc
1a R=R^1=R^2=OAc
4 R=H, R^1=R^2=OH
4a R=H, R^1=R^2=OAc

2 R=R^2=OH, R^1=OAc
3 R=R^1=R^2=OH
2a=3a R=R^1=R^2=OAc

The ^1H NMR spectrum of alysine A (**1**) (Table 1) showed two tertiary methyl signals at δ 1.14 (Me-20) and 1.34 (Me-17) and two acetyl group methyls at δ 2.02 and 2.06 as singlets (each 3H). The presence of an α,β-disubstituted furan ring was observed at δ 7.37 and 6.24 (each 1H, d, J_{vic}=2 Hz). A pair of oxymethylene protons as narrow doublets (J=3 Hz) in upper field at δ 3.08 and 2.62 was indicative of a 4α,18-spiro-oxirane ring at C-4 which is typical location for neo-clerodane diterpenoids. In addition, one pair of oxygenated methylene group was observed at δ 4.27 and 4.68 (each 1H, d, J=12 Hz) attributing to C-19 protons. Two oxygenated methine protons were observed at δ 4.45 (ddd, J=3.5, 11 and 12 Hz) and δ 4.59 (t, J=2 Hz), their location followed from spin decoupling experiments and deduced that the former at C-1 next to a hydroxyl group and the latter at C-3 next to an acetyl group. Other ^1H NMR signals belonging to ring A were at δ 2.31 (d, J=11, H-10), δ 2.28 (m, H-2α) and δ 1.92 (dddd, J=2, 3.5, 11 and 15 Hz, H-2ß). Spin decoupling experiments also showed the relations between the protons C_1,C_{10} as well as between the protons of C_{11},C_{12}. The ^{13}C NMR spectrum (BB, APT and DEPT) (Table 1) indicated four methyl quartets, five methylene triplets, six methine doublets and nine carbon singlets for 24 carbon atoms. The carbonyl signals were observed at δ 206.70, 170.13 and 169.68, the last two belonging the acetyl carbonyls. In DEPT and APT spectra, three aliphatic oxygenated methine carbons were observed at δ 65.00 (C-1), 74.60 (C-3), 75.40 (C-6) while oxygenated methylene carbons were at δ 49.20 (C-18) and 62.90 (C-19) being in a good agreement with the ^1H NMR spectrum. Acetylation of **1** yielded **1a** with two more acetyl groups. In the ^1H NMR spectrum of **1a** the acetyl signals were at δ 2.02 (3H, s), 2.06 (3H, s) and 2.12 (6H, s), the signal at δ 4.45 was shifted to δ 5.65 (1H, ddd, J=5, 11 and 12 Hz, H-1α) and the doublet at δ 3.80 (H-6β) to δ 4.86 indicating that two hydroxyl groups were at C-1 and C-6 while the signals for C-19 protons (δ 4.27 and 4.68) and H-3β (4.59) did not shift upon acetylation. The chemical shift of H-3 also indicated the stereochemistry of the acetyl group as α, when the acetyl group is β the chemical shift of H-3 would be around 5.2-5.5 ppm[8-10]. The IR spectrum of **1** was consistent with the presence of the acetyl group(s) (1740, 1720,

Table 1. ^{1}H and ^{13}C NMR data of Compounds **1**, **2**, **3** and **4** in $CDCl_3$*.

	1		**2**		**3**		**4**	
	^{1}H	^{13}C	^{1}H	^{13}C	^{1}H	^{13}C	^{1}H	^{13}C
1	4.45	65.00	4.39	64.96	4.47	65.00	--	18.64
2	2.28; 1.92	40.60	2.42; 1.92	37.86	2.42; 1.92	39.78	--	31.63
3	4.59	74.60	5.29	71.28	4.09	74.31	3.36	74.00
4	--	63.27	--	71.37	--	76.99	--	66.24
5	--	45.60	--	44.79	--	45.15	--	44.06
6	3.80	75.40	3.92	75.93	3.92	74.31	3.70	74.00
7	--	206.70	--	206.83	--	206.41	--	207.38
8	--	53.91	--	53.49	--	53.71	--	50.89
9	--	49.20	--	52.44	--	52.70	--	49.53
10	2.31	45.73	2.40	42.02	2.45	42.17	2.30	41.96
11	2.55	19.30	2.01; 2.42	18.94	1.95; 2.50	19.32	--	17.23
12	1.61; 2.84	33.62	1.61; 2.84	34.45	1.60; 2.84	34.92	--	32.37
13	--	116.30	--	116.54	--	116.61	--	115.41
14	--	151.90	--	151.21	--	152.36	--	151.84
15	6.24	110.44	6.22	110.25	6.22	110.47	6.22	110.42
16	7.37	142.50	7.38	142.45	7.35	142.74	7.25	142.57
17	1.34	19.19	1.42	18.08	1.42	18.57	1.37	18.44
18	3.08; 2.62	49.20	4.22; 4.06	66.21	4.16; 4.02	66.48	2.58; 3.13	50.89
19	4.27; 4.68	62.90	4.41; 5.15	65.50	4.37; 5.15	60.63	4.49; 4.61	62.23
20	1.14	17.82	1.21	17.49	1.23	17.72	1.02	18.90
CO	--	170.13	--	169.97	--	170.06	--	169.83
CH_3	2.02	20.70	1.99	20.17	1.96	20.55	2.02	20.73
CO	--	169.70	--	169.59	--	169.81	--	--
CH_3	2.06	20.91	2.05	20.49	2.02	20.79	--	--
CO	--	--	-	169.59	--	170.05	--	--
CH_3	--	--	2.08	20.76	--	--	--	--

*δ values are given in ppm, relative to TMS as an internal standard and assignments are based on spin decoupling, HETCOR, HMBC and SINEPT experiments in compounds **1** and **2**, spin decoupling and HETCOR experiments in **3** and **4**.

1240 cm^{-1}) and oxo group (1710 cm^{-1}), the placement of the oxo group at C-7 followed by the selective INEPT experiments. Irradiation of the signal at δ 3.80 (H-6) enhanced the signals at δ 206.70 (C-7) (two bonds away), 63.27 (C-4) (three bonds away), and 49.20 (C-9 and C-18) (both four bonds away). Irradiation of the signal at δ 1.34 (Me-17) enhanced the following signals at δ 206.70 (C-7), 151.90 (C-14) (both three bonds away), 53.91 (C-8) (two bonds away), 45.73 (C-10) (four bonds away).

Neo-clerodane diterpenoids obtained from nature contain monosubstituted furan ring while in the present case, compounds with α,ß-disubstituted furan ring were isolated for the first time. In addition, the presence of oxygen functions both at C-3 and C-7 are fairly rare[11]. Unambiguous assignment of the protons and carbons and the substitution of furan ring followed from the HETCOR (Table 1), HMBC and SINEPT experiments and confirmed by X-ray analysis. Figure 1 is a thermal ellipsoid plot of compound **1**, the X-ray analysis data were given in Table 2. The A and B rings exhibited chair conformations and were *trans* fused. The C ring was *cis* fused to the B ring and exhibited a half-chair conformation resulting in the mean plane of the C ring being perpendicular to the mean plane of the A and B rings. There was an intramolecular hydrogen bond between O(7) and O(5) and an intermolecular hydrogen bond between O(1) and carbonyl oxygen O(8).

Alysine B (2). Isolated as colorless crystalline compound. The FAB and HR EIMS indicated a molecular formula $C_{26}H_{34}O_{11}$ (*m/z* 522.2101). The ^{1}H NMR spectrum showed two methyl signals at δ 1.21 and 1.42 (each 3H, s) and three acetyl methyls at δ 1.99, 2.05 and 2.08 (each 3H, s). The 4α,18-spiro-oxirane ring signals observed in compound **1** were missing while the furan ring signals were present at δ 6.22 (H-15) and 7.38 (H-16) (each 1H, J_{vic}=2.0 Hz). In the ^{1}H NMR spectrum, two large doublets at δ 4.41 (H-19a) and 5.15 (H-19b) J_{gem}=13.5 Hz indicating the presence of an acetoxymethylene group at C-5, two more doublets at δ 4.06 and 4.22 with a geminal coupling of 12.5 Hz suggested a CH_2OH or CH_2OAc group replacing the spiro-oxirane group at C-4. Other ^{1}H NMR signals were quite similar to those of compound **1** observing at δ 4.39 (ddd, J=5, 10 and 11 Hz, H-1α), δ 2.40 (d, J=10 Hz, H-10), δ 1.92 (ddd, J=3.5, 13 and 14.5 Hz, H-2ß) and 2.42 (m, H-2α), and at δ 5.29 (t, J=3 Hz, H-3β). The relation between H_1-H_3 and H_1,H_{10} were shown by spin decoupling experiments. The ^{13}C NMR (APT) spectrum (Table 1) indicated five methyl quartets, five methylene triplets, six methine doublets and ten quaternary carbon signals for 26 carbon atoms. The carbonyl singlets were at δ 206.83, 169.97 and 169.59, the last two signals corresponded to three acetyl groups. The IR spectrum correlated the carbonyl groups with the signals at 1740, 1735, 1725 and 1717 cm^{-1}. Four oxygenated carbon atoms, similar to those of **1**, at δ 64.96 (C-1), 71.28 (C-3), 75.93 (C-6), 71.37 (C-4) were present, the only important change from compound **1** was at C-4 (δ 71.37) indicating that the epoxy group at C-4 in **1** was opened up to give a CH_2OH and OH groups, due to this reason H-3 was shifted to δ 5.29 from δ 4.59. Spin decoupling, HETCOR and HMBC experiments permitted unambigous assignment of protons and carbons. Acetylation of **2** yielded **2a** exhibiting two more acetyl signals at δ 2.12 and 2.14 and the signals were shifted from δ 4.39 (1H, ddd, J=4, 10 and 12 Hz, H-1α) to δ 5.60, and from δ 3.92 (1H, d, J=1 Hz, H-6β) to δ 5.15 while the signal at δ 5.29 didn't move indicating that one of the acetyl groups was placed at C-3. The X-ray analysis established the relative stereochemistry of compound **2** (Figure 1). The conformation of the ring system is the same as in compound **1** (Table 2). Additional intramolecular hydrogen bonding occurs due to the hydroxyl group at C-4.

3-Deacetylalysine B (3). The HR EIMS of compound **3** indicated a molecular formula $C_{24}H_{32}O_{10}$ (*m/z* 480.1988). The ^{1}H NMR spectrum showed two methyl signals at δ 1.23 and 1.42 (each 3H, s) and two acetyl signals at δ 1.96 and 2.02 (each 3H, s). The 4α,18-spiro-oxirane ring was missing in compound **3**. The presence of two pairs of

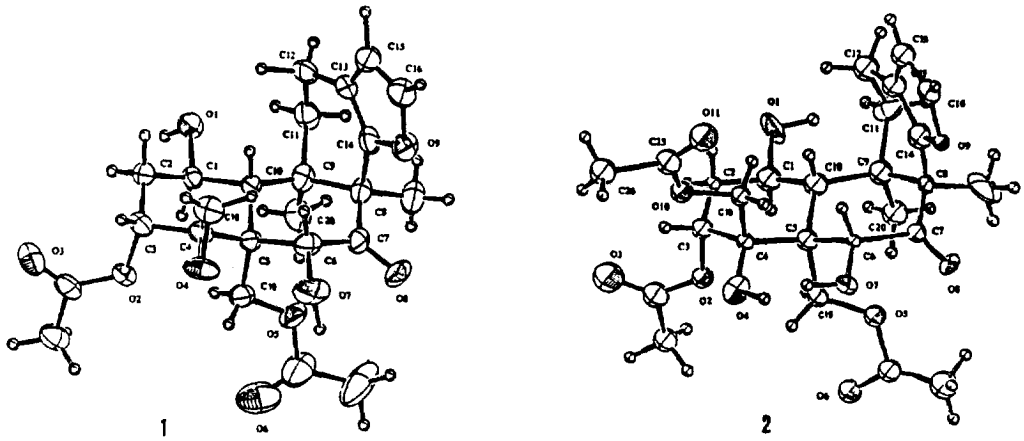


Figure 1

Table 2. Crystal Data, Data Collection and Refinement Parameters of Compounds **1** and **2**.

Compound	**1**	**2**
Formula	$C_{24}H_{30}O_9$	$C_{26}H_{34}O_{11}$
fw	462.50	522.55
crys. syst.	orthorombic	monoclinic
space group	$P2_12_12_1$	$P2_1$
crys. dimens., mm	0.20 x 0.20 x 0.30	0.15 x 0.02 x 0.30
a, A°	15.505 (7)	8.901 82)
b, A°	15.902 (4)	13.228 (2)
c, A°	9.360 (3)	11.156 (3)
ß (°)	-	101.4 (2)
z	4	2
V, A°	2308 (2)	1287.8 (6)
D (calcd.) g cm^{-3}	1.331	1.347
radiation	CuKα	CuKα
abs. coeff (μ), cm-1	8.10	8.44
F(000), e	984	556
temp, °C	23	23
diffractometer	Rigaku AFC6S	Rigaku AFC6S
scan mode	ω-2θ	ω-2θ
$2\theta_{max}$	158.0°	157.8°
total data collected	4752	5324
unique data	2711	2796
observed data used	3023 [I>3σ(I)]	2106 [I>3σ(I)]
no. of params. refined	383	179
max shift/error on final cycle	0.05	0.18
max. resid. density, e /A°3	0.21	1.35
R, Rw	0.055; 0.047	0.178; 0.136
GOF = $[\Sigma w(\|Fo\|-\|Fc\|)^2/ (No-Nv)]^{1/2}$	2.73	4.53

methylene signals at δ 4.37 (1H, d, J=13.5 Hz, H-19a), 5.15 (1H, d, J=13.5 Hz, H-19b) and 4.02 (1H, d, J=12.5 Hz, H-18a), 4.16 (1H,d, J=12.5 Hz, H-18b) indicated that compounds **2** and **3** were similar at C-4 and C-5. The C_1-C_3 protons resonated more or less at the same frequencies with those of compounds **1** and **2**, at δ 4.47 (1H, ddd, J=5, 11 and 12 Hz, H-1α), 1.92 (1H, ddd, J=3.5, 11 and 12 Hz, H-2β), 2.42 (1H, dt, J=2 and 12 Hz, H-2α), 4.09 (1H, t, J=2 Hz, H-3β), 2.45 (1H, dd, J=5, 12 Hz, H-10), their relationship were shown by spin decoupling experiments. The ^{13}C NMR (BB and APT) spectra of **3** were similar to that of **2** (Table 1). The difference between these two compounds (**2**, **3**) were observed on the chemical shift of C-3 due to the placement of a hydroxyl instead of an acetyl group. Acetylation of **3** yielded a five acetyl derivative (**3a**), the ^1H NMR spectra of the **2a** and **3a** were exactly the same, therefore, the structure of **3** was decided as 3-deacetylalysine B.

Alysine C (4). The HR EIMS of alysine C (**4**) indicated a molecular formula $C_{22}H_{28}O_7$ (*m/z* 404.1830). The ^1H NMR spectrum showed three methyl singlets at δ 1.02, 1.37 and 2.02, the latter belonging to an acetyl group, and furan ring protons at δ 7.25 (1H, d, J=2 Hz, H-16) and 6.22 (1H, d, J=2 Hz, H-15). The protons at δ 2.58 (1H, d, J=3.5 Hz, H-18a) and 3.13 (1H, d, J=3.5 Hz, H-18b) was indicative of a 4,18-spiro-oxirane ring at C-4. Two large doublets at δ 4.61 (1H, d, J=12.5 Hz, H-19a) and 4.49 (1H, d, J=12.5 Hz, H-19b) were assigned to the presence of a CH_2OAc group at C-5 as observed in the previous compounds. The narrow triplet at δ 3.36 (1H, t, J=3 Hz) indicated the presence of an α hydroxyl group at C-3, the upperfield shift of H-3 showed the presence of 4α,18-spiro-oxirane ring at C-4. The sharp singlet at δ 3.70 indicated the presence of a hydroxyl group at C-6 along with an oxo group at C-7. Acetylation of **4** yielded a three acetyl derivative (**4a**), the acetyl groups were at δ 1.95, 2.02 and 2.06 (each 3H, s), the signals at δ 3.36 and 3.70 were shifted to δ 4.42 (1H, t, J=3 Hz, H-3β) and 4.79 (1H, s, H-6α), respectively, other signals remained unchanged. The ^{13}C NMR spectrum of **4** displayed three methyl quartets, six methylene triplets, four methine doublets (for five carbons) and eight quaternary carbon singlets for 22 carbon atoms, one of quaternary carbons (δ 207.38) was indicative of an isolated carbonyl group which was placed at C-7 as also present in compounds **1**-**3** and the second carbonyl signal at δ 169.83 attributed to the acetyl group. The HETCOR experiment showed the relation between hydrogens and carbons (Table 1).

EXPERIMENTAL

General procedures: IR: Perkin Elmer 983 in $CHCl_3$; ^1H and ^{13}C NMR spectra were recorded on 200 MHz Bruker AC 200L at TUBITAK (Gebze, Turkey), the HMBC and SINEPT experiments were run on 400 MHz Bruker instrument at the University of Georgia (Georgia, Athens).

Plant material: *Teucrium alyssifolium* Stapf. (Lamiaceae) syn. *Teucrium serpentini* Contandr. is an endemic plant to Turkey, it was collected from south-western Turkey (Muğla, Köyceğiz, Sandras mountain) at an elevation 1600 m, in June 1993. The plant was identified by Dr. Kerim Alpınar (Istanbul), a voucher specimen is deposited in the Herbarium of the Faculty of Pharmacy, University of Istanbul, ISTE 65136.

Extraction and Isolation of the compounds. Dried and powdered aerial parts of the plant (1.4 kg) were extracted with acetone at room temperature, evaporated under vacuum, 72 g of a crude extract was obtained. The crude extract was chromatographed over Silica gel using hexane, a gradient of EtOAc up to 100%, followed by EtOH. The collected

fractions were combined after TLC control and they were further separated on small Si gel and Sephadex LH-20 columns as well as on preparative TLC plates. From the preparative TLC separation, alysine A (**1**)(105 mg), alysine B (**2**) (200 mg), 3-deacetylalysine B (**3**)(25 mg) and alysine C (**4**) (15 mg) were obtained.

Alysine A (1). mp 257 °C (MeOH); $[\alpha]_D$ -28.3° (c 3.0, $CHCl_3$); IR ν_{max} ($CHCl_3$) 3470, 1740, 1720, 1710 cm^{-1}; UV λ_{max} (MeOH) (log ϵ) 280 (sh) and 242 (4.2) nm; ^1H and ^{13}C NMR given in Table 1; HR EIMS *m/z* obsd. 462.1884, calcd. for $C_{24}H_{30}O_9$ 462.1889; EIMS *m/z* (%) 462 (M^+, 29.2), 447 (M-Me^+, 5.3), 402 (M-$HOAc^+$, 7.6), 387 (402-Me^+, 14), 367 (26.5), 329 (32.2), 307 (40.9), 235 (36.4), 217 (42.0), 189 (27.3), 161 (37.4), 148 (100), 133 (66.6), 95 (67.5).

Alysine A acetate (1a). IR ν_{max} ($CHCl_3$) 1745, 1740, 1735, 1635, 1500, 14440, 1370, 1240, 760 cm^{-1}; ^1H NMR ($CDCl_3$) δ 5.65 (1H, ddd, J=5, 11, 12 Hz, H-1α), 2.28 (1H, m, H-2α), 1.89 (1H, m, H-2β), 4.59 (1H, t, J=4.5 Hz, H-3β), 4.86 (1H, s, H-6β), 2.31 (1H, d, J=11 Hz, H-10), 2.55 (2H, m, H-11), 1.75 (1H, m, H-12a), 2.67 (1H, br dd, J=3, 15 Hz,H-12b), 6.24 (1H, d, J=2Hz, H-15), 7.37 (1H, d, J=2 Hz, H-16), 2.49 (1H, d, J=3 Hz, H-18a), 2.82 (1H, d, J=3 Hz, H-18b), 4.45 (1H, d, J=12 Hz, H-19a), 4.86 (1H, d, J=12 Hz, H-19b), 1.14 (3H, s, Me-20), 1.34 (3H, s, Me-17), 2.02 (3H, s, OAc), 2.06 (3H, s, OAc), 2.12 (6H, s, 2xOAc); FAB MS (formic acid+glycerol): *m/z* (%) 547 ($M+1^+$, 32.2), 487 (M+1-$HOAc^+$, 27.5), 445 (487-Ac^+, 42.1), 427 (487-$HOAc^+$, 9.9), 385 (17.1), 325 (15.9), 297 (20.0), 237 (33.1), 185 (49.4), 161 (53.3), 148 (100).

Alysine B (2). mp. 160 °C (MeOH); $[\alpha]_D$ -38.6° (c 2.0, $CHCl_3$); IR ν_{max} ($CHCl_3$) 3440, 1740, 1735, 1725, 1717 cm^{-1}; UV λ_{max} (MeOH) (log ϵ) 280 (3.2) and 242 (3.8) nm; ^1H and ^{13}C NMR given in Table 1; HR EIMS *m/z* obsd. 522.2121, calcd. for $C_{26}H_{34}O_{11}$ 522.2100; EIMS *m/z* (%) 522 (M^+, 17.2), 504 (M-H_2O^+, 53.6), 462 (M-$HOAc^+$, 7.2), 431 (24.4), 390 (9.9), 367 (30.2), 217 (62.0), 148 (100), 97 (47).

Alysine B acetate (2a). IR ν_{max} ($CHCl_3$) 3450, 1745, 1740, 1720, 1370, 1240, 1050, 760 cm^{-1}. ^1H NMR ($CDCl_3$) δ 5.6 (1H, ddd, J=5, 10, 11 Hz,H-1α), 1.92 (1H, m, 2β), 2.42 (1H, m, 2α), 5.21 (1H, t, J=3 Hz, H-3β), 5.15 (1H, s, H-6β), 1.7 (1H, m, H-12a), 2.78 (1H, br dd, J=2, 11 Hz, H-12b), 6.22 (1H, d, J=2Hz, H-15), 7.38 (1H, d, J=2 Hz, H-16), 4.02 (1H, d, J=12.5 Hz, H-18a), 4.16 (1H, d, J=12.5 Hz, 18b), 4.37 (1H, d, J=13.5 Hz, H-19a), 5.15 (1H, d, J=13.5, H-19b), 1.12 (3H, s, Me-20), 1.38 (3H, s, Me-17), 1.99 (3H, s, OAc), 2.05 (3H, s, OAc), 2.08 (3H, s, OAc), 2.12 (3H, s, OAc), 2.14 (3H, s, OAc). FAB MS (formic acid + glycerol): *m/z* (%) 649 ($M+1^+$, 2.1), 607 (M+1-Ac^+, 11.3), 589 (M+1-$HOAc^+$, 23.4), 547 (589-Ac^+, 32.0) 487 (547-$HOAc^+$, 19.8), 445 (487-Ac^+, 17.4), 1661 (31.0), 148 (100).

3-Deacetylalysine B (3). Amorphous compound; $[\alpha]_D$ -36.0° (c 0.6, $CHCl_3$); IR ν_{max} 3460, 1740, 1725 cm^{-1}; UV (MeOH) λ_{max} (log ϵ) 272 (2.8) and 239 (4.2) nm; ^1H and ^{13}C NMR given in Table 1; HR EIMS *m/z* obsd. 480.1988 calcd. for $C_{24}H_{32}O_{10}$ 480.1995; EIMS *m/z* (%) 480 (M^+, 45.3), 462 (M-H_2O^+, 100), 420 (M-$HOAc^+$, 15.5), 420 (M-$HOAc^+$, 15.5), 402 (420-H_2O^+, 55.7), 360 (M-2xHOAc, 22.0), 161 (45.0), 149 (100).

3-Deacetylalysine B acetate (3a)= Alysine B acetate (2a). IR ν_{max} ($CHCl_3$) 3450, 1745, 1740, 1720, 1370, 1240, 1050, 760 cm^{-1}; ^1H NMR ($CDCl_3$) δ 5.6 (1H, ddd, J=5, 10, 11 Hz, H-1α), 1.92 (1H, m, 2β), 2.42 (1H, m, 2α), 5.15 (1H, t, J=5.6 Hz, H-3β), 5.10 (1H, s, H-6β), 2.48 (1H, d, J=10 Hz, H-10), 1.95 (1H, m, H-11a), 2.60 (1H, dd, J=5, 15, H-11b), 1.75 (1H, m, H-12a), 2.78 (1H, br dd, J=2, 11 Hz, H-12b), 6.26 (1H, d, J=2 Hz, H-15), 7.37 (1H, d, J=2 Hz, H-16), 4.0 (1H, d, J=12 Hz, H-18a), 4.16 (1H, d, J=12 Hz, H-18b), 4.36 (1H, d, J=13.5 Hz, H-19a), 5.15 (1H, J=13.5 Hz, H-19b), 1.12 (3H, s, Me-20), 1.38 (Me-17), 1.97 (3H, s, OAc). 1.99 (3H, s, OAc), 2.12 (3H, br s, OAc), 2.14 (6H, br s, 2xOAc). EIMS *m/z* (%) 648 (M^+, 2.4), 606 (M-Ac^+, 4.2), 588 (M-$HOAc^+$, 7.3), 546 (M-HOAc-Ac^+, 17.4), 486 (M-2xHOAc-Ac^+, 8.0), 444 (486-Ac^+, 23.7), 161 (42.2), 149 (100).

Alysine C (4). Amorphous compound; $[\alpha]_D$ -24.8° (c 0.4, $CHCl_3$); IR ν_{max} ($CHCl_3$) 3430, 1740, 1620, 1390,

1240, 1050, 760 cm^{-1}; UV (MeOH) λ_{max} (log e) 280 (2.9) and 242 (4.8) nm; ^{1}H and ^{13}C NMR given in Table 1. HR EIMS *m/z* obsd. 404.1830 $[M]^+$ calcd. for $C_{22}H_{28}O_7$ 404.1835, EIMS *m/z* (%) 386 [M-H_2O^+, 8.5], 344 [M-$HOAc^+$, 12.2], 331 [M-CH_2OAc^+, 7.7], 312 (28.7), 285 (24.8), 219 (46.0), 161 (27.3), 149 (100), 83 (75.1), 63 (70.6).

Alysine C acetate (4a). 4.42 (1H, br t, J=3.0 Hz, H-3β), 4.79 (1H, s, H-6β), 6.16 (1H, d, J=2 Hz, H-15), 7.29 (1H, d, J=2 Hz, H-16), 2.48 (1H, d, J=3.5 Hz, H-18a), 2.84 (1H, d, J=3.5 Hz, H-18b), 4.31 (1H, d, J=12.0 Hz, H-19a), 4.77 (1H, d, J=12 Hz, H-19b), 1.39 (3H, s, Me-17), 1.12 (3H, s, Me-20), 2.01 (3H, s, OAc), 2.10 (3H, s, OAc), 2.14 (3H, s, OAc).

X-ray Analysis. All data were collected on a Rigaku AFC-6S diffractometer. Crystal and refinement data are given in Table 2. Crystals of compound **2** were very small and of poor quality. Lorentz-polarization, a Ψ-scan empirical absorption correction, and isotropic extinction corrections were applied. The structure was solved by direct methods and refined by a full-matrix least squares techniques with a weigthing scheme based on the measured esd's. Computer programs used were TEXSAN[x1], SHELXS86[x2], and PLATON-92[x3].

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