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The First Euphane-Type Triterpene Tridesmosides and Bisdesmoside from *Rhoiptelea chiliantha*

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Abstract: Two euphane-type triterpene tridesmosides rhoiptelesides A (1) and B (2), and a bisdesmoside, rhoipteleside E (3) were isolated from the leaves and fruits of *Rhoiptelea chiliantha* Diels et Hand.-Mazz. (Rhoipteleaceae). Their structures were elucidated on the basis of extensive analysis of their 1D and 2D-NMR spectral data and chemical evidence. These compounds represent the first example of the glycoside of euphane-type triterpene. © 1997 Elsevier Science Ltd.

INTRODUCTION

Rhoiptelea chiliantha Diels et Hand.-Mazz., which is distributed in Yunnnan, Guizhou and Guangxi Provinces of China and northern Vietnam, is the sole species of the monotypic family Rhoipteleaceae. Since 1930's, this plant has been widely studied from the morphological, anatomical and palynological aspects, however the systematic position of this family still remains obscure.[1] From the viewpoint of chemotaxonomy, we have investigated the chemical constituents of this plant, and reported the structures of a rearranged ursane triterpene,[2] triterpene caffeates [3] and triterpene-lignan esters from barks,[4] diarylheptanoids [5] and dimeric ellagitannins formed by intermolecular oxidative C-C coupling [6] from fruits and leaves. Further studies on the chemical constituents of leaves and fruits led to the isolation of three triterpene glycosides which were named rhoiptelesides A (**1**), B (**2**) and E (**3**). We described herein the isolation and structure elucidation of these novel compounds.

RESULTS AND DISCUSSION

The MeOH extract of the air-dried leaves was suspended in H_2O, and extracted with Et_2O and EtOAc, successively. The remaining water layer was separated by a combination of column chromatographies over Sephadex LH-20, MCI-gel CHP 20P and silica gel to afford rhoiptelesides A (**1**), B (**2**) and E (**3**).

Compounds **1** and **3** were also obtained from the MeOH extract of the fruits by similar isolation procedure.

Rhoipteleside A (**1**) was isolated as a white amorphous powder and gave an $[M+Na]^+$ peak at *m/z* 919 in positive FAB-MS spectrum. Careful analyses of ^{1}H-NMR and ^{1}H-^{1}H COSY spectral data of **1** revealed the presence of a fucopyranose and two rhamnopyranose residues in the molecule. In the ^{13}C-NMR spectrum of **1**, 30 signals, *i.e.*, eight methyls, seven methylenes, nine methines and six quaternary carbon signals (Table 1), were observed besides sugar carbon signals, thus indicating that **1** is a triterpene glycoside.

Table 1. ^{13}C-NMR spectral data of the aglycones of **1**-**3**

	1[a)]	1[b)]	2[a)]	3[c)]		1[a)]	1[b)]	2[a)]	3[c)]
C-1	32.9	32.6	32.9	32.7	C-16	29.3	28.4	29.2	29.2
2	21.3	20.7	21.3	26.6	17	55.0	54.1	54.8	54.9
3	80.8	78.9	80.8	77.1	18	22.3	21.9	22.1	22.0
4	38.6	37.8	38.6	38.7	19	14.1	13.6	14.3	14.3
5	46.1	44.9	46.2	45.4	20	34.1	33.4	34.0	34.1
6	25.0	24.1	25.0	25.2	21	19.9	19.4	19.9	19.9
7	121.9	121.5	121.6	121.6	22	42.4	41.5	42.4	42.5
8	144.5	143.8	144.4	144.6	23	71.4	71.0	71.3	71.4
9	54.9	54.1	54.8	54.7	24	126.1	126.0	126.1	126.2
10	38.0	37.4	38.0	37.9	25	139.3	137.2	139.3	139.3
11	72.3	73.5	72.2	72.3	26	26.1	25.8	26.1	26.1
12	44.6	44.2	44.3	44.2	27	18.7	18.4	18.6	18.7
13	45.1	44.3	45.1	45.2	28	29.7	29.5	29.6	28.9
14	52.6	51.8	52.5	52.6	29	22.8	22.7	22.7	22.7
15	35.5	35.1	35.3	35.4	30	28.4	28.4	28.2	28.2

a) 125 MHz in CD_3OD; *b*) 125 MHz in C_5D_5N; *c*) 75 MHz in CD_3OD

The detailed analyses of the aglycone signals using the ^{1}H-^{1}H COSY and HSQC techniques disclosed three partial structural units shown by heavy lines in Fig. 1. This was also supported by analysis of the HMBC spectrum, which showed the two- and three-bond correlations between H-1 and C-2; between H-3 and C-1; between H-7 and both C-5 and C-9; between H-11 and C-12; between H$_3$-21 and C-17, C-20 and C-22; between H-23 and C-20; and between H-24 and C-22, C-26 and C-27 (Fig. 1), respectively, confirmed above three partial structures. Furthermore, the HMBC correlations of the five individual tertiary methyl signals on the rings A~D [between H$_3$-28 (δ 0.95) and C-29, C-4 and C-3; between H$_3$-29 (δ 0.96) and both C-28 and C-5; between H$_3$-19 (δ 0.94) and C-1, C-5 and C-9; between H$_3$-30 (δ 0.93) and C-8, C-13 and C-15; and between H$_3$-18 (δ 0.91) and C-12, C-13 and C-17] firmly established the linkages of these partial structural units. Thus, the plane structure of the aglycone was unequivocally elucidated as shown in Fig. 1. The locations of two rhamnoses and a fucose at C-3 (δ 80.8), C-23 (δ 71.4) and C-11 (δ 72.3), respectively, were also established by the observation of the HMBC correlations of the oxygen-bearing carbon signals of the

aglycone with each anomeric protons. This fact indicated that **1** is a triterpene tridesmoside. Comparison of the ^{13}C-NMR spectral data (C-1 ~ C-6) of the rhamnose moieties in **1** with those of the reported α-rhamnopyranosides[7] illustrated α anomeric configurations for both rhamnopyranoses. The β anomeric configuration of the fucopyranose was judged from its $^{3}J_{H1, H2}$ coupling constant (J=8 Hz).

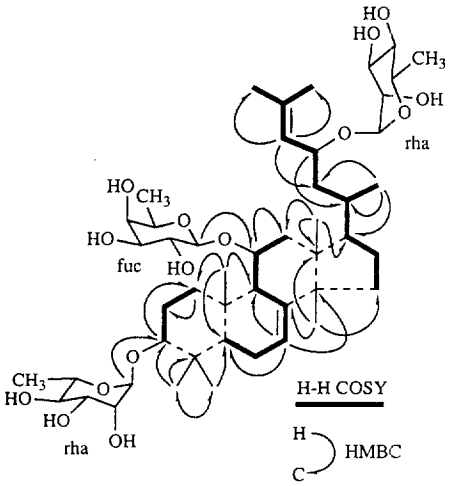
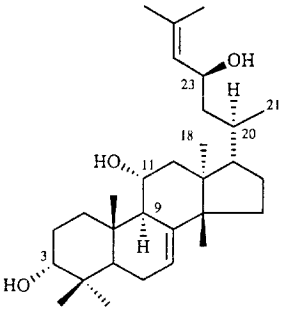
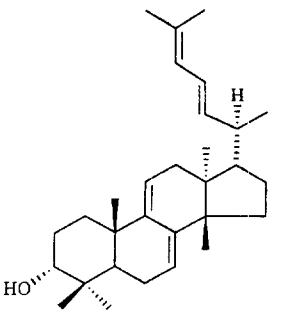


Fig. 1. The Partial Structures (Heavy Lines) and HMBC Correlations of **1**



1a



1b

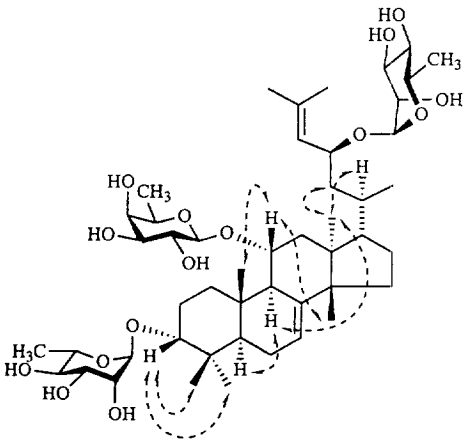


Fig. 2. ROESY Correlations of **1**

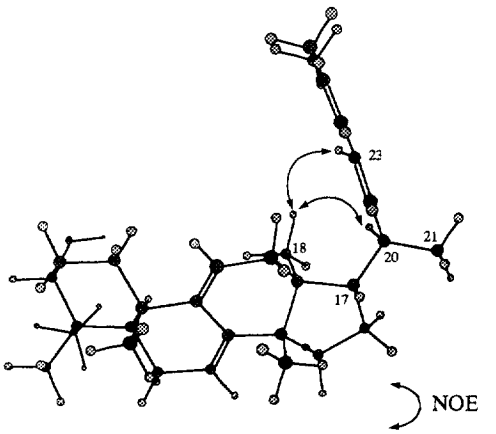
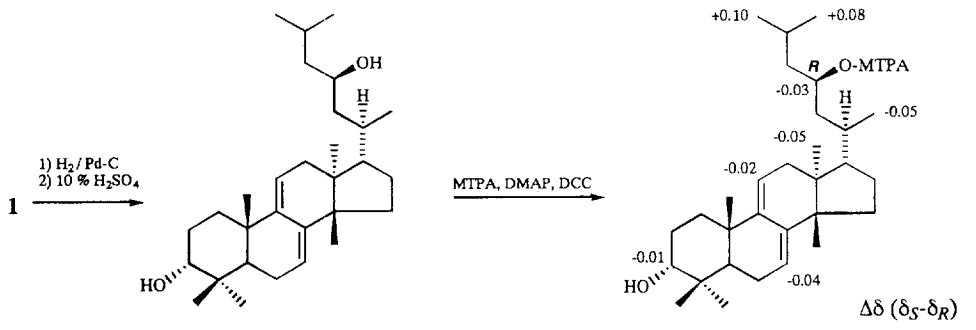


Fig. 3. Key NOE Correlations of **1b**

The relative configuration of the aglycone was determined as follows: first, the small coupling constant of H-3 indicated that it is in an *equatorial* position, and the large coupling constant (11 Hz) between H-9 and H-11 revealed *trans* di-*axial* relationship. Next, the relative configurations of the methyl groups and other

protons in the rings A-D were ascertained on the basis of the ROESY correlations (Fig. 2). Thus, the aglycone of **1** was deduced to be an euphane or tirucallane-type triterpene differing only in the configuration at C-20. Hydrolysis of **1** in a basic condition (25 % NaOH in *n*-butanol) [8] afforded the genuine aglycone **1a**, which was suggested to be an euphane-type triterpene by comparing ^{1}H-NMR chemical shift (δ 0.85, d, *J*=6 Hz) of 21-Me with those of related tirucallane and euphane triterpenes reported in the references.[9] On the other hand, hydrolysis of **1** in an acidic condition (10 % H_2SO_4) yielded an artificial aglycone **1b** along with L-rhamnose and D-fucose. A careful spin decoupling and a differential NOE experiment of **1b** showed the large coupling constant (10 Hz) between H-17 and H-20, and the NOE between 18-Me and H-20, respectively, indicating a *pseudo* 1, 3-*diaxial* correlation between H-20 and 18-Me. This is consistent with the the X-ray crystallographic studies reported on tirucallane and euphane-type triterpenes.[10] Furthermore, the NOE between 18-Me and H-23, and the absence of NOE between 18-Me and 21-Me (Fig. 3) collaborated that the configuration of C-20 of **1b** is *S**, *i.e.*, euphane-type.

To determine the absolute configuration of C-23, modified Mosher's method [11] was applied to 23-*O*-(*R*)-α-methoxy-α-(trifluoromethyl)-phenylacetic acid (MTPA) ester (**1d**) and 23-*O*-(*S*)-MTPA ester (**1e**), which were derived from **1** by successive hydrogenation, hydrolysis, and acylation (chart 1). The positive Δδ (δ_S-δ_R) values observed for H_3-26 and H_3-27 proton signals and negative Δδ values for H-3, H-7, H-11 and H_3-18 proton signals unequivocally indicated that the absolute configuration of C-23 of **1c** is *R*. Consequently, the configuration for C-23 in compound **1** was determined to be *S*. On the basis of the above results, the structure of rhoipteleside A was established to be as shown by the formula **1**. Rhoipteleside A is a triterpene tridesmoside having a novel euphane-type triterpene as the aglycone which was not found in this plant.



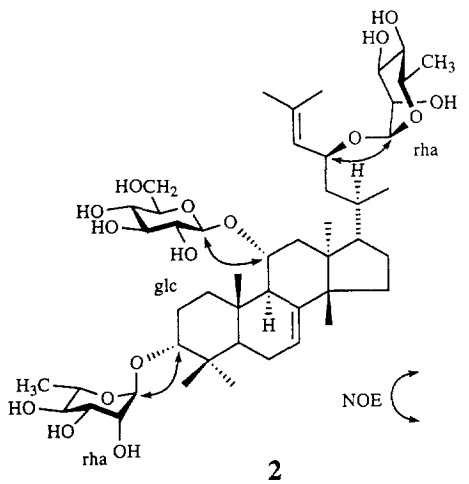
1c **1d** and **1e**

Chart 1

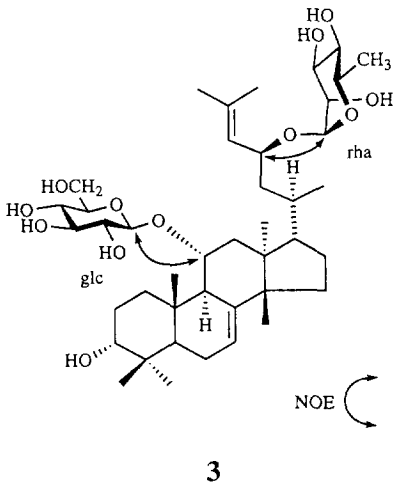
Rhoipteleside B (**2**) was isolated as a white amorphous powder. Its positive FAB-MS exhibited an $[M+Na]^+$ ion peak at *m/z* 935, which was 16 mass unit more than that of **1**. The ^{1}H and ^{13}C-NMR spectra of

2 closely resembled those of **1**, especially the aglycone signals in the ^{13}C-NMR spectrum were almost superimposable to those of **1** (Table 1), suggesting that **2** is also an euphane triterpene tridesmoside. The only difference was the appearance of the signals due to a glucopyranose residue instead of those of the fucopyranose residue. The locations of two rhamnoses and a glucose were determined to be at C-3, C-23 and C-11, respectively, by the observations of NOEs between the anomeric protons and oxygen-bearing methine protons in the NOESY spectrum. Consequently, the structure of **2** was assigned to rhoipteleside B.

Rhoipteleside E (**3**) was indicated to be a bisdesmoside because only two anomeric proton signals were observed in the ^{1}H-NMR spectrum. These two sugars were elucidated to be a rhamnopyranose and a glucopyranose by analyzing the ^{1}H and ^{13}C-NMR data of **3** and its acetate (**3a**). The ^{13}C-NMR signals arising from the aglycone were almost identical to those of **1**, except for the downfield shift of C-2 and upfield shift of C-3 (Table 1). These findings suggested that **3** possesses the same aglycone as that of **1** and **2**, and the C-3 hydroxyl group is free. This was further confirmed by the observation that H-3 of **3a** largely shifted to lower field ($\Delta\delta$+1.36) compared to that of **3** in the ^{1}H-NMR spectrum. The glucose and rhamnose were established to be located at C-11 and C-23 because the NOE correlations were observed between their anomeric protons and H-11 and H-23, respectively. Accordingly, the structure of rhoipteleside E was represented as formula **3**.



2



3

To the best of our knowledge, this is the first report on the glycoside of euphane-type triterpene, and rhoiptelesides A and B are the triterpene tridesmosides which are extremely rare in the nature.[12] From the chemotaxonomical viewpoint, the presence of these unique constituents in Rhoipteleaceae supports the establishment of the order Rhoipteleales. [1]

EXPERIMENTAL

General. Optical rotations were measured with a JASCO DIP-370 digital polarimeter. ^1H and ^{13}C-NMR spectra were recorded on Varian Unity plus 500, Varian Gemini 300 and Varian Gemini 200 spectrometers. Coupling constants are expressed in Hz, and chemical shifts are given on a δ (ppm) scale with tetramethylsilane as an internal standard. MS were recorded on a JEOL JMS DX-303 spectrometer, and glycerol was used as a matrix for FAB-MS measurement. Column chromatographies were performed with Kieselgel 60 (70-230 mesh, Merck), MCI-gel CHP 20P (75-150 μm, Mitsubishi Chemical Co.), Sephadex LH-20 (25-100 μm, Pharmacia Fine Chemical Co. Ltd.), Si-5 MPLC (10 μm, Kusano). Thin layer chromatography (TLC) was performed on precoated Kieselgel 60 F_{254} plates (0.2 mm thick, Merck), and spots were detected by ultraviolet (UV) illumination and by spraying 10 % sulfuric acid reagent.

Plant Material. The fruits and leaves of *Rhoiptelea chiliantha* were collected in Guangxi, China in October, 1988. A voucher specimen has been deposited in the Laboratory of Plant Chemotaxonomy, China Pharmaceutical University, Nanjing, China.

Extraction and Separation. The MeOH extract of the air-dried leaves (510 g) was suspended in H_2O, and sequentially extracted with Et_2O and EtOAc. The remaining H_2O layer was subjected to column chromatographies over Sephadex LH-20 with water containing an increasing amount of methanol. The fraction eluted with H_2O was further separated by MCI-gel CHP 20P (60 ~100 % MeOH) and silica gel ($CHCl_3$: MeOH: H_2O= 9:1:0.1~ 7:3:0.5) column chromatographies to afford **1** (1.8 g), **2** (234 mg) and **3** (150 mg). The MeOH extracts of air-dried fruits (495 g) was partitioned between Et_2O and H_2O. The H_2O layer was further extracted with EtOAc. The EtOAc layer was concentrated to give a residue (9.0 g) which was chromatographed over MCI CHP-20P with 20 ~100 % MeOH. The 60~80 % MeOH eluates were separated by silica gel chromatography ($CHCl_3$: MeOH: H_2O= 9:1:0.1~ 7:3:0.5) to furnish **1** (88 mg) and **3** (51 mg).

Rhoipteleside A (1). A white amorphous powder, $[\alpha]_D^{15}$ -65.1° (*c* 0.4, MeOH). *Anal.* Calcd for $C_{48}H_{80}O_{15} \cdot 2.5\ H_2O$: C, 61.19; H, 9.09. Found: C, 61.05; H, 8.75. Positive FAB-MS *m/z*: 919 $(M+Na)^+$. ^1H-NMR (500 MHz, CD_3OD): aglycone-δ 5.34 (1H, dd, *J*=3, 7 Hz, H-7), 4.97 (1H, dt, *J*=1, 10 Hz, H-24), 4.51 (1H, m, H-11), 4.44 (1H, m, H-23), 3.34 (1H, br. s, H-3), 2.50 (1H, dd, *J*=3, 11 Hz, H-9), 2.37 (1H, dd, *J*=8, 13 Hz, H_2-12), 2.23 (1H, d, *J*=14 Hz, H_2-1), 2.08 (1H, m, H_2-16), 2.03 (1H, m, H_2-6), 2.00 (1H, m, H_2-22), 1.96 (1H, m, H_2-6), 1.77 (3H, d, *J*=1 Hz, H_3-26), 1.77 (1H, m, H-5), 1.73 (3H, d, *J*=1 Hz, H_3-27), 1.73 (1H, m, H_2-12), 1.71 (1H, m, H_2-2), 1.64, 1.60 (each 1H, m, H_2-15),1.56 (2H, m, H_2-1, H-17), 1.54 (1H, m, H_2-2), 1.42 (1H, m, H_2-16), 1.40 (1H, m, H_2-22), 1.31 (1H, m, H-20), 0.96 (3H, s, H_3-29), 0.95 (3H, s, H_3-28), 0.94 (3H, s, H_3-19), 0.93 (3H, s, H_3-30), 0.91 (3H, s, H_3-18), 0.89

(3H, d, *J*=6 Hz, H_3-21). 3-rhamnose-δ 4.79 (1H, d, *J*=1.6 Hz, H-1), 3.82 (1H, dd, *J*=2, 3 Hz, H-2), 3.69 (1H, dd, *J*=3, 10 Hz, H-3), 3.39 (1H, t, *J*=10 Hz, H-4), 3.72 (1H, dq, *J*=10, 6 Hz, H-5), 1.24 (3H, d, *J*=6 Hz, H-6); 23-rhamnose-δ 4.67 (1H, d, *J*=1.4 Hz, H-1), 3.69 (1H, dd, *J*=1, 3 Hz, H-2), 3.68 (1H, dd, *J*=3, 9 Hz, H-3), 3.36 (1H, t, *J*=9 Hz, H-4), 3.62 (1H, dq, *J*=9, 6 Hz, H-5), 1.27 (3H, d, *J*=6 Hz, H-6); fucose-δ 4.30 (1H, d, *J*=8 Hz, H-1), 3.40 (1H, dd, *J*=8, 10 Hz, H-2), 3.50 (1H, dd, *J*=4, 10 Hz, H-3), 3.59 (1H, dd, *J*=2, 4 Hz, H-4), 3.58 (1H, m, H-5), 1.25 (3H, d, *J*=7 Hz, H-6). ^{13}C-NMR (125 MHz, CD_3OD): aglycone see Table-1. 3-rhamnose-δ 97.9 (C-1), 73.10 (C-2), 72.7 (C-3), 74.0 (C-4), 70.3 (C-5), 18.0 (C-6); 23-rhamnose-δ 98.0 (C-1), 72.6 (C-2), 72.5 (C-3), 74.2 (C-4), 69.8 (C-5), 18.2 (C-6); fucose-δ 101.2 (C-1), 72.5 (C-2), 75.2 (C-3), 73.08 (C-4), 71.4 (C-5), 16.9 (C-6). ^{1}H-NMR (500 MHz, C_5D_5N): aglycone-δ 5.47 (1H, d, *J*=3 Hz, H-7), 5.17 (1H, dt, *J*=9, 1 Hz, H-24), 4.79 (1H, m, H-23), 4.73 (1H, ddd, *J*=6, 8, 11 Hz, H-11), 3.52 (1H, br. s, H-3), 2.87 (1H, d, *J*=14 Hz, H-1), 2.74 (2H, m, H-9, 12), 2.12 (2H, m, H-12, 22), 1.78 (3H, d, *J*=1 Hz, H_3-27), 1.64 (3H, s, H_3-26), 1.25 (3H, s, H_3-19), 1.06 (3H, s, H_3-30), 1.03 (3H, s, H_3-28), 0.98 (3H, d, *J*=6 Hz, H_3-21), 0.97 (3H, s, H_3-29), 0.74 (3H, s, H_3-18); 3-rhamnose-δ 5.29 (1H, d, *J*=1.4 Hz, H-1), 4.52 (1H, dd, *J*=1, 2 Hz, H-2), 4.49 (1H, dd, *J*=2, 9 Hz, H-3), 4.26 (1H, t, *J*=9 Hz, H-4), 4.27 (1H, m, H-5), 1.64 (3H, d, *J*=6 Hz, H-6); 23-rhamnose-δ 5.43 (1H, d, *J*=1.6 Hz, H-1), 4.53 (1H, dd, *J*=1, 3 Hz, H-2), 4.63 (1H, dd, *J*=3, 9 Hz, H-3), 4.28 (1H, t, *J*=9 Hz, H-4), 4.38 (1H, dq, *J*=9, 6 Hz, H-5), 1.64 (3H, d, *J*=6 Hz, H-6); fucose-δ 4.78 (1H, d, *J*=8 Hz, H-1), 4.42 (1H, dd, *J*=8, 9 Hz, H-2), 4.05 (1H, dd, *J*=4, 9 Hz, H-3), 3.36 (3H, d, *J*=4 Hz, H-4), 3.79 (1H, q, *J*=6 Hz, H-5), 1.55 (1H, d, *J*=6 Hz, H-6). ^{13}C-NMR (125 MHz, C_5D_5N): aglycone see Table-1. 3-rhamnose-δ 97.7 (C-1), 73.0 (C-2), 72.9 (C-3), 74.0 (C-4), 70.3 (C-5), 18.6 (C-6); 23-rhamnose-δ 98.4 (C-1), 73.1 (C-2), 72.9 (C-3), 74.3 (C-4), 70.0 (C-5), 18.8 (C-6); fucose-δ 102.8 (C-1), 72.0 (C-2), 75.2 (C-3), 72.4 (C-4), 71.4 (C-5), 17.4 (C-6).

Alkaline Hydrolysis of 1. **1** (300 mg) was dissolved in *n*-butanol (20 ml) containing 5 g of NaOH. The solution was refluxed at 110°C for 36 h. After extraction with H_2O, *n*-butanol layer was concentrated and subjected to a silica gel chromatography to give **1a** (15 mg), a white amorphous powder, $[\alpha]_D^{22}$ -39.0° (*c* 0.2, $CHCl_3$). EI-MS *m/z*: 458 $(M)^+$. ^{1}H-NMR (300 MHz, $CDCl_3$): δ 5.30 (1H, dd, *J*=3, 7 Hz, H-7), 5.12 (1H, dt, *J*=10, 1 Hz, H-24), 4.45 (1H, dt, *J*=3, 10 Hz, H-23), 4.20 (1H, dt, *J*=5 Hz, H-11), 3.46 (1H, t, *J*=2 Hz, H-3), 1.74, 1.72 (each 3H, d, *J*=1 Hz, H_3-26, 27), 0.94, 0.92, 0.89, 0.88, 0.87 (each 3H, s, methyls), 0.845 (3H, d, *J*=5.7 Hz, H_3-21). ^{13}C-NMR (75 MHz, $CDCl_3$): δ 143.1 (C-8), 136.0 (C-25), 127.8 (C-24), 119.8 (C-7), 76.0 (C-3), 67.5 (C-11), 67.2 (C-23), 56.4 (C-17), 53.2 (C-9), 51.2 (C-14), 48.3, 44.2, 44.1, 43.2, 37.6, 36.4, 34.0, 33.1, 32.2, 28.0, 27.9, 27.5, 25.9, 25.5, 24.1, 21.8, 21.0, 19.0, 18.3, 14.1.

Acid Hydrolysis of 1. A solution of **1** (400 mg) in 2M H_2SO_4 (20 ml) was refluxed at 95°C for 18 h.

The reaction mixture was extracted with EtOAc and the organic layer was evaporated to dryness. The residue was applied to a silica gel chromatography (*n*-hexane - EtOAc = 8:1 ~ 2:1) to afford **1b** (32 mg). **1b**: a white amorphous powder. $[\alpha]_D^{20}$ -44.4°(*c* 0.3, $CHCl_3$), EI-MS *m/z*: 422 (M^+). ^{1}H-NMR (500 MHz, $CDCl_3$): δ 6.14 (1H, dd, *J*=11, 15 Hz, H-23), 5.76 (1H, dd, *J*=1, 11 Hz, H-24), 5.36 (1H, dd, *J*=9, 15 Hz, H-22), 5.31, 5.20 (each 1H, t, *J*=3 Hz, H-7, 11), 3.44 (1H, br. s, H-3), 0.95 (3H, d, *J*=8 Hz, H_3-21), 1.76, 1.73 (each 3H, s, H_3-26, 27), 0.95, 0.932, 0.929, 0.83, 0.64 (each 3H, s, methyls). ^{13}C-NMR (75 MHz, $CDCl_3$): δ 144.9 (s), 141.7 (s), 138.4 (d), 132.7 (s), 125.3 (d), 124.6 (d), 118.3 (d), 115.4 (d), 76.4 (d), 51.3 (d), 49.5 (s), 44.3 (s), 42.5 (d), 41.1 (d), 37.7 (s), 37.4 (t), 36.1 (s), 31.3 (t), 29.7 (t), 27.9 (q), 27.7 (t), 26.0 (q), 25.6 (t), 23.7 (q), 23.1 (t), 22.5 (q), 21.6 (q), 20.7 (q), 18.3 (q), 16.6 (q). The water layer was neutralized with 1% NaOH and evaporated to dryness. The residue was passed through silica gel ($CHCl_3$-MeOH-H_2O = 7:3:0.5) to give a mixture of sugars, which was acetylated with pyridine (0.5 ml) and Ac_2O (0.5 ml) at room temperature overnight. The acetylated sugars were separated by Si-5 MPLC (*n*-hexane-EtOAc=3:1) to afford 1, 2, 3, 4-*O*-tetraacetyl-β-L-rhamnopyranose [7 mg, $[\alpha]_D^{12}$ -51.1° (*c* 0.5, $CHCl_3$); standard: $[\alpha]_D^{12}$-54.6° (*c* 1.6, $CHCl_3$)], 1, 2, 3, 4-*O*-tetraacetyl-β-D-fucopyranose [4 mg, $[\alpha]_D^{12}$ +47.3° (*c* 0.2, $CHCl_3$); standard: $[\alpha]_D^{12}$ +45.1° (*c* 0.3, $CHCl_3$)].

Catalytic Reduction of 1 Followed by Acid Hydrolysis. A solution of **1** (60 mg) in EtOH (15 ml) was stirred with 5 % Pd-C (50 mg) for 23 h under H_2 atmosphere. After removal of the catalyst by filtration, the filtrate was concentrated under reduced pressure and purified by a silica gel chromatography ($CHCl_3$-MeOH-H_2O = 8:2:0.2) to give the product (45 mg) as a white amorphous powder, $[\alpha]_D^{12}$ -4.8°(*c* 1.0, MeOH). Positive FAB-MS *m/z*: 921 $(M+Na)^+$. ^{1}H-NMR (200 MHz, CD_3OD): δ 5.37 (1H, s, H-7), 4.79, 4.75 (each 1H, d, *J*=1 Hz, rha-1 × 2), 4.25 (1H, d, *J*=8 Hz, fuc-1), 0.85-1.10 (methyls). This product (31 mg) was hydrolyzed by heating with 10% H_2SO_4 (4 ml) and dioxane (2 ml) at 95°C for 10 h. The mixture was extracted with Et_2O, dried with Na_2SO_4, and evaporated to dryness. The residue was chromatographed on silica gel (*n*-hexane-EtOAc =6:1~4:1) to afford **1c** (4.6 mg): a white amorphous powder, $[\alpha]_D^{12}$ -91.0° (*c* 0.04, $CHCl_3$). EI-MS *m/z*: 442 (M^+). ^{1}H-NMR (200 MHz, $CDCl_3$): δ 5.34, 5.22 (each 1H, t, *J*=3 Hz, H-7, 11), 3.80 (1H, m, H-23), 3.46 (1H, br. s, H-3), 0.96 (3H, s), 0.94 (6H, s), 0.92, 0.89 (9H, d, *J*=6 Hz), 0.85, 0.65 (each 3H, s).

Synthesis of MTPA Esters of 1c. A solution of **1c** (2 mg), dicyclohexylcarbodiimide (4 mg), 4-dimethylaminopyridine (2 mg) and (*R*)-(+)-α-methoxy-α-(trifluoromethyl)-phenylacetic acid (8 mg) in CH_2Cl_2 (0.3 ml) was left to stand at room temperature for 12 h. The resulting mixture was purified by a silica gel chromatography with *n*-hexane-EtOAc (10:1 ~ 7:1) to give **1d** (0.7 mg): ^{1}H-NMR (500 MHz, $CDCl_3$): δ 5.339 (1H, br. s, H-11), 5.211 (1H, d, *J*=3 Hz, H-7), 5.239 (t, *J*=12 Hz, H-23), 3.465 (1H, br. s, H-3), 0.960, 0.946, 0.943, 0.840 (each 3H, s, H_3-19, 28, 29, 30), 0.932 (3H, d, *J*=6 Hz, H_3-21), 0.834, 0.807 (each 3H, d, *J*=7 Hz, H_3-26, 27), 0.641 (3H, s, H_3-18). The use of (*S*)-(-)-α-methoxyl-α-

(trifluoromethyl)-phenylacetic acid gave **1e** (0.9 mg): ^{1}H-NMR (500 MHz, $CDCl_3$): δ 5.319 (1H, br. s, H-11), 5.170 (1H, d, *J*=3 Hz, H-7), 5.214 (t, *J*=12 Hz, H-23), 3.459 (1H, br. s, H-3), 0.953, 0.942, 0.942, 0.830 (each 3H, s, H_3-19, 28, 29, 30), 0.885 (3H, d, *J*=6 Hz, H_3-21), 0.916, 0.908 (each 3H, d, *J*=7 Hz, H_3-26, 27), 0.589 (3H, s, H_3-18).

Rhoipteleside B (2). A white amorphous powder, $[\alpha]_D^{15}$ -66.3°(*c* 0.2, MeOH). *Anal.* Calcd for $C_{48}H_{80}O_{16} \cdot 2\,H_2O$: C, 60.74; H, 8.92. Found: C, 60.56; H, 8.37. Positive FAB-MS *m/z*: 935 $(M+Na)^+$. ^{1}H-NMR (500 MHz, CD_3OD): aglycone-δ 5.33 (1H, d, *J*=3 Hz, H-7), 4.97 (1H, d, *J*=10 Hz, H-24), 4.53 (1H, ddd, *J*=5, 9, 11 Hz, H-11), 4.44 (1H, dt, *J*=4, 10 Hz, H-23), 3.31 (1H, br. s, H-3), 2.50 (1H, dd, *J*=3, 10 Hz, H-9), 2.40 (1H, dd, *J*=9, 13 Hz, H-12), 1.78 (3H, d, *J*=1 Hz, H_3-26), 1.74 (3H, d, *J*=1 Hz, H_3-27), 0.96, 0.95 × 2, 0.93, 0.91 (each 3H, s, H_3-18, 19, 28, 29, 30), 0.89 (3H, d, *J*=6 Hz, H_3-21). 3-rhamnose-δ 4.78 (1H, d, *J*=2 Hz, H-1), 3.81 (1H, dd, *J*=2, 3 Hz, H-2), 3.68 (1H, dd, *J*=3, 9 Hz, H-3), 3.39 (1H, t, *J*=9 Hz, H-4), 3.72 (1H, dq, *J*=9, 6 Hz, H-5), 1.24 (3H, d, *J*=6 Hz, H-6); 23-rhamnose-δ 4.68 (1H, d, *J*=1 Hz, H-1), 3.69 (1H, dd, *J*=1, 3 Hz, H-2), 3.68 (1H, dd, *J*=3, 9 Hz, H-3), 3.36 (1H, t, *J*=9 Hz, H-4), 3.65 (1H, dq, *J*=9, 6 Hz, H-5), 1.28 (3H, d, *J*=6 Hz, H-6); glucose-δ 4.40 (1H, d, *J*=8 Hz, H-1), 3.13 (1H, dd, *J*=8, 9 Hz, H-2), 3.39 (1H, t, *J*=9 Hz, H-3), 3.24 (2H, m, H-4, H-5), 3.65 (1H, dd, *J*=6, 12Hz, H-6a), 3.88 (1H, dd, *J*=2, 12 Hz, H-6b). ^{13}C-NMR (125 MHz, CD_3OD): aglycone see Table-1. 3-rhamnose-δ 97.8 (C-1), 73.1 (C-2), 72.6 (C-3), 73.9 (C-4), 70.3 (C-5), 17.9 (C-6); 23-rhamnose-δ 98.0 (C-1), 72.6 (C-2), 72.5 (C-3), 74.2 (C-4), 69.8 (C-5), 18.1 (C-6); glucose-δ 100.5 (C-1), 75.4 (C-2), 77.8 (C-3), 72.0 (C-4), 78.1 (C-5), 63.3 (C-6);

Rhoipteleside E (3). Colorless needles, mp 176-178 °C, $[\alpha]_D^{15}$ -68.2°(*c* 0.4, MeOH). *Anal.* Calcd for $C_{42}H_{70}O_{12} \cdot 2.5\,H_2O$: C, 62.12; H, 9.31. Found: C, 61.81; H, 9.01. Positive FAB-MS *m/z*: 789 $(M+Na)^+$. ^{1}H-NMR (500 MHz, CD_3OD): aglycone-δ 5.33 (1H, d, *J*=3 Hz, H-7), 4.97 (1H, d, *J*=10 Hz, H-24), 4.51 (1H, ddd, *J*=5, 9, 11 Hz, H-11), 4.45 (1H, dt, *J*=4, 10 Hz, H-23), 3.31 (1H, br. s, H-3), 2.59 (1H, dd, *J*=3, 11 Hz, H-9), 2.37 (1H, dd, *J*=8, 13 Hz, H-12), 1.77 (3H, d, *J*=1 Hz, H_3-26), 1.73 (3H, d, *J*=1 Hz, H_3-27), 0.93, 0.92 × 2, 0.91 × 2 (each 3H, s, H_3-18, 19, 28, 29, 30), 0.89 (3H, d, *J*=6 Hz, H_3-21). rhamnose-δ 4.68 (1H, d, *J*=1 Hz, H-1), 3.70 (1H, dd, *J*=1, 3 Hz, H-2), 3.65 (2H, m, H-3, 5), 3.36 (1H, t, *J*=9 Hz, H-4), 1.28 (3H, d, *J*=6 Hz, H-6); glucose-δ 4.39 (1H, d, *J*=8 Hz, H-1), 3.14 (1H, dd, *J*=8, 9 Hz, H-2), 3.38 (1H, t, *J*=9 Hz, H-3), 3.24 (1H, t, *J*=9 Hz, H-4), 3.23 (1H, m, H-5), 3.65 (1H, m, H-6a), 3.88 (1H, dd, *J*=2, 10 Hz, H-6b). ^{13}C-NMR (75 MHz, CD_3OD): aglycone see Table-1. rhamnose-δ 97.9 (C-1), 72.7 (C-2), 72.6 (C-3), 74.2 (C-4), 69.9 (C-5), 18.2 (C-6); glucose-δ 100.4 (C-1), 75.4 (C-2), 77.9 (C-3), 72.0 (C-4), 78.1 (C-5), 63.4 (C-6).

Acetylation of 3. **3** (15 mg) was acetylated with pyridine (0.5 ml) and Ac_2O (0.5 ml) at room

temperature overnight to give **3a** (12 mg): a white amorphous powder, $[\alpha]_D^{15}$ -50.1° (*c* 0.4, $CHCl_3$). Positive FAB-MS *m/z*: 1125 $(M+Na)^+$. ^{1}H-NMR (300 MHz, $CDCl_3$): δ 5.32 (1H, dd, *J*=2, 4 Hz, rha-2), 5.30 (1H, dd, *J*=4, 10 Hz, rha-3), 5.22 (1H, t, *J*=10 Hz, rha-4), 5.08 (1H, s, H-7), 5.08, 5.07 (each 1H, t, *J*=10 Hz, glc-3, 4), 4.96 (1H, dd, *J*=8, 10 Hz, glc-2), 4.77 (1H, d, *J*=10 Hz, H-24), 4.70 (1H, d, *J*=2 Hz, rha-1), 4.67 (1H, s, H-3), 4.66 (1H, d, *J*=8 Hz, glc-1), 4.28, 4.42 (each 1H, m, H-11, 23), 4.24 (1H, dd, *J*=3, 12 Hz, glc-6a), 4.15 (1H, dd, *J*=4, 12 Hz, glc-6b), 3.90 (1H, dq, *J*=6, 10 Hz, rha-5), 3.73 (1H, ddd, *J*=2, 4, 10 Hz, glc-5), 2.16, 2.14, 2.12, 2.09, 2.05, 2.00, 1.98, 1.97 (each 3H, s, acetyl × 8), 1.75, 1.71 (each 3H, s, H_3-26, 27), 1.25 (3H, d, *J*=6 Hz, rha-6), 0.96, 0.89, 0.87, 0.86, 0.83 (each 3H, s, Me × 5), 0.85 (3H, d, *J*=6 Hz, H_3-21).

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