# Squalene-Derived Triterpene Polyethers from the Red Alga *Laurencia omaezakiana*

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In our continuing search on halogenated metabolites from species of the red algal genus *Laurencia*, a novel squalene-derived triterpene polyether, named omaezakianol (**2**), was isolated from *Laurencia omaezakiana* MASUDA along with 15,16-anhydrothyrsiferol (**3**). Their structures were determined by spectral and chemical methods.

**Introduction.** – Species of the red algal genus *Laurencia* (Rhodomelaceae, Ceramiales) are known to be prolific sources of a variety of halogenated secondary metabolites, particularly sesquiterpenoids, diterpenoids, triterpenoids, and $C_{15}$ acetogenins [1][2]. Some of these halogenated compounds showed antimicrobial, insecticidal, cytotoxic, and feeding-deterrent activities.

In connection with our chemotaxonomic studies on *Laurencia* species from Japanese waters, we previously reported the isolation and structure elucidation of a pentacyclic triterpene alcohol, enshuol (**1**), which has a 2,8-dioxabicyclo[5.4.0]undecane molecular skeleton, from *Laurencia omaezakiana* MASUDA ('*Enshu-sozo*' in Japanese), collected at Omaezaki, Shizuoka Prefecture [3]. Although the absolute configurations at C(3), C(6), and C(7) of the 2,8-dioxabicyclo[5.4.0]undecane moiety were determined, the configurations at C(10) to C(22) remained unsettled[3]). Recently, the structure of enshuol, including the absolute configuration, was established as formula **1** by the asymmetric total synthesis [4]. Further investigation of this species collected at Enoshima, Kanagawa Prefecture, led to the isolation of a novel tetracyclic polyether triterpene alcohol **2**, which we named omaezakianol[3]), along with 15,16-anhydrothyrsiferol[3]) (**3**). Herein, we describe the isolation and structure determination of these metabolites.

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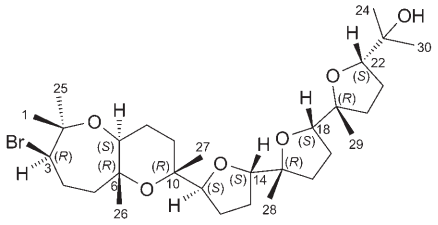
[3]) Trivial atom numbering; for systematic names of **2**, **3**, and **5**–**7**, see *Exper. Part.*



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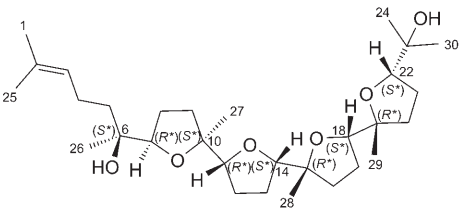

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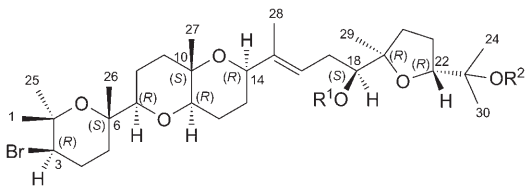

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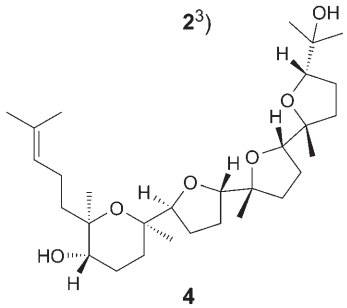
**7**[3]) $R^1 = R^2 = Ac$



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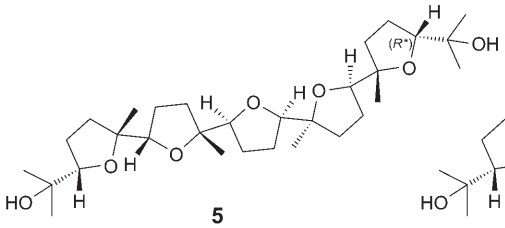

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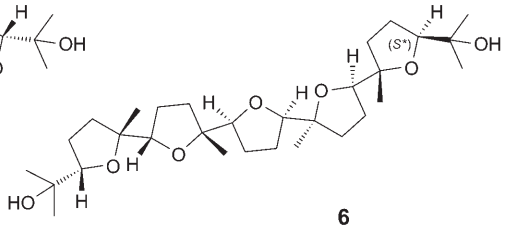

**6**

**Results and Discussion.** – A combination of column and thin-layer chromatography of the MeOH extract from the sample collected at Enoshima, Kanagawa Prefecture, gave omaezakianol (**2**) and 15,16-anhydrothyrsiferol (**3**) in 15 and 3% yield, respectively, based on the extract.

Omaezakianol (**2**) was analyzed for $C_{30}H_{52}O_6$ by its HR-FAB-MS. Its IR spectrum showed absorption at $\tilde{\nu}_{max}$ 3455 $cm^{-1}$ due to OH group(s).

The $^1$H- and $^{13}$C-NMR data (*Table*), together with the $^1$H,$^1$H-COSY, HOHAHA, and HMBC data (*Fig.*) and the FD- and FAB-MS led to the assignment of a planar formula **2**, consisting of four tetrahydrofuran units, for omaezakianol.

The $^1$H-NMR spectrum showed the presence of eight tertiary Me groups, five CH H-atoms adjacent to an O-atom, and an olefinic H-atom. As shown in the *Figure*, the $^1$H,$^1$H-COSY and HOHAHA data indicated the presence of a 4-methylpent-3-enyl group, three $-CH_2-CH_2-CH-O-$ moieties, and a $-O-CH-CH_2-CH_2-CH-O-$ moiety. Since **2** has five degrees of unsaturation, **2** must be composed of four O-containing rings. The chemical shift values ($\delta$(C) 84–86) of the corresponding ring C-atoms in the $^{13}$C-NMR spectrum suggested that these O-containing rings are tetrahydrofuran moieties. This was confirmed by the mass spectra (FD- and FAB-MS), which showed fragment ions at *m*/*z* 143, 227, and 211 (*Fig.*). The same fragment ions were also observed in the MS of a degradation product **4** derived from enshuol (**1**) by treatment with zinc and AcOH in MeOH [3].

Table. *$^{13}C$-* (DEPT) *and $^{1}H$-NMR Data* (100 and 400 MHz, resp.; $CDCl_3$) *of Omaezakianol*[3]) (**2**). Assignments were corroborated by $^{1}H,^{1}H$-COSY, HSQC, and HMBC experiments. $\delta$ in ppm, $J$ in Hz.

| | $\delta$(H) | $\delta$(C) | | $\delta$(H) | $\delta$(C) |
|---|---|---|---|---|---|
| Me(1) | 1.66 (*s*) | 25.7 | $CH_2$(16) | 1.70–1.95 (*m*), 1.95–2.18 (*m*) | 35.8 |
| C(2) | – | 131.3 | $CH_2$(17) | 1.38–1.60 (*m*), 1.70–1.95 (*m*) | 28.6 |
| H–C(3) | 5.04–5.12 (*m*) | 124.8 | H–C(18) | 4.01 (*dd*, *J* = 10.3, 5.9) | 84.1 |
| $CH_2$(4) | 1.95–2.18 (*m*) | 22.4 | C(19) | – | 85.5 |
| $CH_2$(5) | 1.25–1.36 (*m*), 1.38–1.60 (*m*) | 38.5 | $CH_2$(20) | 1.38–1.60 (*m*), 1.95–2.18 (*m*) | 31.0 |
| C(6) | – | 73.1 | $CH_2$(21) | 1.70–1.95 (*m*), 1.95–2.18 (*m*) | 26.5 |
| H–C(7) | 3.87 (*dd*, *J* = 7.1, 7.1) | 84.6 | H–C(22) | 3.82 (*dd*, *J* = 7.3, 5.8) | 85.5 |
| $CH_2$(8) | 1.70–1.95 (*m*), 1.95–2.18 (*m*) | 26.2 | C(23) | – | 71.6 |
| $CH_2$(9) | 1.38–1.60 (*m*), 1.95–2.18 (*m*) | 32.0 | Me(24) | 1.05 (*s*) | 25.2 |
| C(10) | – | 84.8 | Me(25) | 1.59 (*s*) | 17.6 |
| H–C(11) | 3.82 (*dd*, *J* = 9.5, 6.1) | 85.0 | Me(26) | 1.21 (*s*) | 24.7 |
| $CH_2$(12) | 1.38–1.60 (*m*), 1.70–1.95 (*m*) | 27.9 | Me(27) | 1.14 (*s*) | 24.7 |
| $CH_2$(13) | 1.70–1.95 (*m*) | 26.5 | Me(28) | 1.15 (*s*) | 21.0 |
| H–C(14) | 3.75 (*dd*, *J* = 7.3, 7.3) | 83.7 | Me(29) | 1.13 (*s*) | 25.0 |
| C(15) | – | 84.2 | Me(30) | 1.22 (*s*) | 28.1 |

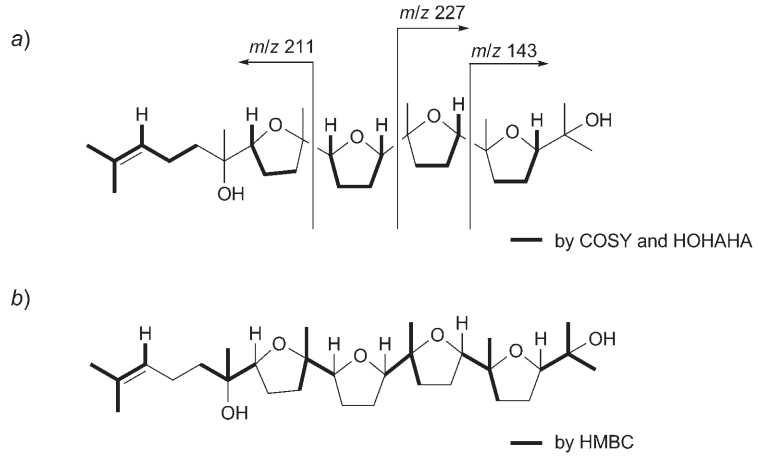


Figure. a) *Selected fragment ions* (*m*/z) *in the FD-MS and FAB-MS and correlations from COSY and HOHAHA;* b) *long-range correlations from HMBC*

Confirmation of the planar structure and determination of the relative configuration of **2** were made as follows. Treatment of omaezakianol (**2**) with 3-chloroperbenzoic acid and $Na_2HPO_4$ in $CH_2Cl_2$ followed by treatment with a trace of *p*-toluenesulfonic acid gave two isomeric pentacyclic compounds, **5** and **6**, having the molecular formula $C_{30}H_{52}O_7$, in 41 and 44% yield, respectively. Compound **5** showed 15 C-signals in the $^{13}C$-NMR spectrum, while the isomeric compound **6** showed more than 15 C-signals, thus indicating that **5** and **6** have a symmetrical and unsymmetrical structure, respectively. Fortunately, the symmetrical compound **5** was found to be identical with a synthetic *meso* compound [5], the structure of which was incorrectly

proposed for glabrescol that has been isolated from the branches and wood of *Spathelia glabrescens* [6], by comparison of the spectral properties. The weak optical rotation of **5** must be ascribed to a small amount of concomitant impurity. Hence, compound **6** is an epimer at C(3) of **5**. Thus omaezakianol is represented by formula **2** with a (6*R**,7*S**,10*R**,11*S**,14*R**,15*S**,18*R**,19*S**,22*R**) configuration. The asymmetric total synthesis of (+)-omaezakianol is in progress.

Compound **3** having a molecular formula $C_{30}H_{51}BrO_6$, revealed in its $^1$H- and $^{13}$C-NMR spectra signals very similar to those of 15,16-anhydrothyrsiferyl diactate (**7**), which has previously been isolated from *Laurencia saitoi* PERESTENKO (as *Laurencia obtusa* (HUDSON) LAMOUROUX) [7][8]. Extensive spectral analysis by 2D-NMR ($^1$H,$^1$H-COSY, HOHAHA, HSQC, HMBC, and NOESY data) strongly suggested **3** to be 15,16-anhydrothyrsiferol (thyrsiferol = ($\alpha^2$*S*,2*R*,5*R*)-$\alpha^2$-{(3*S*)-3-{(2*R*,4a*R*,6*R*,8a*S*)-6-[(2*S*,5*R*)-5-bromotetrahydro-2,6,6-trimethyl-2*H*-pyran-2-yl]octahydro-8a-methylpyrano[3,2-*b*]pyran-2-yl}-3-hydroxybutyl}tetrahydro-$\alpha^5$,$\alpha^5$,2-trimethylfuran-2,5-dimethanol). Treatment of **3** with $Ac_2O$ and *N*,*N*-dimethylpyridin-4-amine (DMAP) in $CH_2Cl_2$ gave the corresponding diacetate, which was identical with 15,16-anhydrothyrsiferyl diactate (**7**) in all respects.

To the best of our knowledge, 15,16-anhydrothyrsiferol (**3**) has first been found in the present study. Closely related triterpenoids have previously been isolated from other *Laurencia* species: 15,28-anhydrothyrsiferol (as dehydrothyrsiferol) from *Laurencia pinnatifida* (GMAL. LAMOUR) [9] and 10-epi-15,28- and 10-epi-15,16-anhydrothyrsiferol from *Laurencia viridis* sp. nov [10].

Omaezakianol (**2**) and 15,16-anhydrothyrsiferol (**3**) were also isolated from the Omaezaki sample [3] in 7 and 3% yield, respectively; however, enshuol (**1**) was not found in the Enoshima sample (see *Introduction*). Within the Japanese species of the genus *Laurencia* [2], *L. omaezakiana* was found to produce only triterpenoids as characteristic metabolites. The present study strongly suggests that *L. omaezakiana* may include chemical races as in the case of *Laurencia nipponica* YAMADA [11][12].

## Experimental Part

*General*. Normal-phase high-performance liquid chromatography (HPLC): *Shim-Pack Prep-Sil* (4.6 mm × 250 mm; *Shimadzu*). Column chromatography (CC): silica gel (Kieselgel *60*, 70–230 mesh; *Merck*). Prep. TLC: precoated silica gel plate (Kieselgel $60_{254S}$, 20 cm × 20 cm, *Merck*). Optical rotation: *Jasco-DIP-140* polarimeter; in $CHCl_3$. IR Spectra: *Jasco-A-102* spectrophotometer; $\tilde{\nu}_{max}$ in cm$^{-1}$. $^1$H- and $^{13}$C-NMR Spectra: *Jeol-JNM-FX-400* spectrometer (at 400 and 100 MHz, resp.); referencing to $SiMe_4$ as int. standard; $\delta$ in ppm, *J* in Hz. Low- and high-resolution MS: *Jeol-JMS-DX303* spectrometer for EI and *Jeol-JMS-HX110* spectrometer for FAB and FD; in *m*/*z* (rel. intensity).

*Plant Material*. A specimen of *Laurencia omaezakiana* MASUDA was collected at Enoshima, Kanagawa Prefecture, on 18th August, 1994. A voucher specimen was deposited with the Herbarium of Graduate School of Science, Hokkaido University (SAP 062279).

*Extraction and Isolation*. Partially dried alga (22.7 g) was immersed in MeOH (300 ml). The MeOH soln. was concentrated, and the residue partitioned between $Et_2O$ and $H_2O$. The $Et_2O$ soln. was washed with $H_2O$, dried ($Na_2SO_4$), and concentrated to give a dark green oil (496 mg). This extract (292 mg) was then fractionated by CC ($SiO_2$, step gradient hexane/AcOEt). The fraction eluted with AcOEt was further subjected to CC ($CHCl_3$/MeOH 98:2) followed by prep. TLC (toluene/AcOEt 7:3): 15,16-anhydrothyrsiferol (**3**; 8.8 mg, 3.0% based on the extract). The CC fractions eluted with hexane/AcOEt 3:1 and hexane/AcOEt 1:1 were further subjected to CC (step gradient toluene/AcOEt). The fraction

eluted with toluene/AcOEt 1:1 was then separated by prep. TLC ($CHCl_3$/MeOH 98:2): omaezakianol (**2**; 43.8 mg, 15%).

*Omaezakianol* (= rel-*(α⁵*R,*2*R,*2′*S,*2″*S,*2‴*S,*5*S,*5′*R,*5″*R,*5‴*R)-Hexadecahydro-α⁵,α⁵‴,α⁵‴,2,2″,2‴-hexamethyl-α⁵-(4-methylpent-3-en-1-yl)-[2,2′:5′,2″:5″,2‴-quaterfuran]-5,5‴-dimethanol*; **2**). Colorless oil. $[\alpha]_D^{20} = +15.8$ ($c = 0.59$, $CHCl_3$). IR (neat): 3455, 1340, 1318, 1302, 1183, 1078, 955, 925, 901, 755. $^1$H- and $^{13}$C-NMR: *Table*. FD-MS: 509 (100, $[M+H]^+$), 365 (8, $[M-C_8H_{15}O_2]^+$), 227 (16, $[M-C_{17}H_{29}O_3]^+$), 211 (5, $[M-C_{17}H_{29}O_4]^+$), 143 (10, $[M-C_{22}H_{37}O_4]^+$). FAB-MS (pos.): 509 (100, $[M+H]^+$), 491 (64, $[M-H_2O]^+$), 227 (84, $[M-C_{17}H_{29}O_3]^+$), 211 (40, $[M-C_{17}H_{29}O_4]^+$), 143 (83, $[M-C_{22}H_{37}O_4]^+$). HR-FAB-MS (pos.): 509.3831 ($[M+H]^+$, $C_{30}H_{53}O_6^+$; calc. 509.3842).

*15,16-Anhydrothyrsiferol* (=*(α²*S,*2*R,*5*R)-α²-{(*2*E)-3-{(*2*R,*4a*R,*6*R,*8a*S)-6-{(*2*S,*5*R)-5-Bromotetrahydro-2,6,6-trimethyl-2*H-pyran-2-yl}octahydro-8a-methylpyrano[3,2-b]pyran-2-yl}but-2-en-1-yl}tetrahydro-α⁵,α⁵,2-trimethylfuran-2,5-dimethanol*; **3**). Amorphous solid. $[\alpha]_D^{22} = +13.1$ ($c = 0.53$, $CHCl_3$). IR ($CHCl_3$): 3650, 3520, 1159, 1147, 1125, 1105, 1078, 1045, 978, 915. $^1$H-NMR: 1.13 (*s*, Me(24)); 1.16 (*s*, Me(29)); 1.20 (*s*, Me(26)); 1.21 (br. *s*, Me(27), Me(30)); 1.27 (*s*, Me(25)); 1.40 (*s*, Me(1)); 1.66 (*s*, Me(28)); 1.50–1.93 (*m*, $CH_2$(5), $CH_2$(8), $CH_2$(9), $CH_2$(12), $H_a$–C(13), $H_a$–C(20), $CH_2$(21)); 2.10–2.16 (*m*, $H_a$–C(4), $H_b$–C(13), $H_a$–C(17), $H_b$–C(20)); 2.18–2.30 (*m*, $H_b$–C(4), $H_b$–C(17)); 3.08 (*dd*, $J$ = 11.5, 2.2, H–C(7)); 3.47 (*dd*, $J$ = 11.2, 6.4, H–C(11)); 3.56 (*dd*, $J$ = 9.8, 2.9, H–C(18)); 3.76 (*dd*, $J$ = 10.0, 6.1, H–C(22)); 3.89 (*dd*, $J$ = 12.2, 3.9, H–C(3)); 4.24 (*dd*, $J$ = 8.8, 3.9, H–C(14)); 5.56 (*dd*, $J$ = 7.3, 6.8, H–C(16)). $^{13}$C-NMR: 13.04 (Me(28)); 19.90 (Me(27)); 20.12 (Me(26)); 23.67 (Me(1), Me(29)); 24.03 (Me(24)); 27.71 (Me(30)); 31.04 (Me(25)); 21.82 ($CH_2$(9)); 23.01 ($CH_2$(8)); 25.82 ($CH_2$(13)); 26.57 ($CH_2$(21)); 28.29 ($CH_2$(4)); 30.43 ($CH_2$(17)); 32.01 ($CH_2$(20)); 37.09 ($CH_2$(5)); 38.77 ($CH_2$(12)); 59.05 (CH(3)); 75.20 (CH(14)); 76.72 (CH(18)); 78.38 (CH(11)); 86.63 (CH(7)); 87.60 (CH(22)); 122.3 (CH(16)); 70.48 (C(23)); 72.46 (C(10)); 74.43 (C(6)); 74.69 (C(2)); 85.83 (C(19)); 138.9 (C(15)). FD-MS: 589 and 587 (30 and 32, $[M+H]^+$), 445 and 443 (15 and 17, $[M-C_8H_{15}O_2]^+$), 207 and 205 (20 and 19, $[M-C_{22}H_{37}O_5]^+$), 143 (29, $[M-C_{22}H_{36}BrO_4]^+$). EI-MS: 588 and 586 (0.3 and 0.3, $M^+$), 570 and 568 (0.5 and 0.5, $[M-H_2O]^+$), 529 and 527 (0.2 and 0.2, $[M-C_3H_7O]^+$), 445 and 443 (0.5 and 0.4, $[M-C_8H_{15}O_2]^+$), 291 and 289 (2.9 and 2.8, $[M-C_{17}H_{29}O_4]^+$), 143 (100, $[M-C_{22}H_{36}BrO_4]^+$). HR-EI-MS: 586.2852 ($M^+$, $C_{30}H_{51}^{79}BrO_6^+$; calc. 586.2869).

*Transformation of* **2** *into* **5** *and* **6**. To a soln. of **2** (10 mg) in $CH_2Cl_2$ (2 ml) were added 3-chloroperbenzoic acid (9 mg) and $Na_2HPO_4 \cdot 12\,H_2O$ (5 mg), and the mixture was stirred for 3 h at 0–20°. Then a trace of *p*-toluenesulfonic acid was added, and the mixture was further stirred for 1 h. The mixture was extracted with $CHCl_3$, and the $CHCl_3$ soln. was successively shaken with sat. $Na_2S_2O_3$/$Na_2CO_3$ soln. 1:2 and sat. brine, dried ($Na_2SO_4$), and concentrated. The resulting material (13.5 mg) was subjected to HPLC (hexane/$CHCl_3$/MeOH 625:370:5, flow rate 1 ml/min, RI detector: **5** (4.2 mg, 41%; $t_R$ 26 min) and **6** (4.5 mg, 44%; $t_R$ 38 min).

rel-*(2*R,*2′*S,*2″*S,*2‴*S,*2⁗*S,*5*S,*5′*R,*5″*R,*5‴*R,*5⁗*R)-Eicosahydrooctamethyl-α⁵,α⁵,α⁵⁗,α⁵⁗,2,2‴,2⁗,5′-[2,2′:5′,2″:5″,2‴:5‴,2⁗-quinquefuran]-5,5⁗-dimethanol* (**5**): Colorless oil. $[\alpha]_D^{17} = +0.59$ ($c = 1.00$, $CHCl_3$). IR (neat): 3455, 1338, 1319, 1302, 1260, 1183, 1080, 998, 955, 923, 900, 803, 755. $^1$H-NMR: 1.06 (*s*, Me(1), Me(30)); 1.14 (*s*, Me(26), Me(29)); 1.15 (*s*, Me(27), Me(28)); 1.24 (*s*, Me(24), Me(25)); 1.45 (*ddd*, $J$ = 12.1, 8.7, 5.9, $H_a$–C(5), $H_a$–C(20)); 1.52–1.66 (*m*, $H_a$–C(8), $H_a$–C(9), $H_a$–C(12), $H_a$–C(13), $H_a$–C(16), $H_a$–C(17)); 1.79–1.94 (*m*, $H_a$–C(4), $H_b$–C(8), $H_b$–C(12), $H_b$–C(13), $H_b$–C(17), $H_a$–C(21)); 2.03–2.13 (*m*, $H_b$–C(4), $H_b$–C(9), $H_b$–C(16), $H_b$–C(21)); 2.25 (*ddd*, $J$ = 12.0, 9.3, 7.3, $H_b$–C(5), $H_b$–C(20)); 3.73 (br. *dd*, $J$ = 5.4, 5.4, H–C(3), H–C(22)); 3.84 (*dd*, $J$ = 7.8, 5.9, H–C(11), H–C(14)); 4.02 (*dd*, $J$ = 10.3, 5.4, H–C(7), H–C(18)). $^{13}$C-NMR: 22.57 (Me(27), Me(28)); 25.02 (Me(26), Me(29)); 25.29 (Me(1), Me(30)); 28.09 (Me(24), Me(25)); 26.56 ($CH_2$(4), $CH_2$(21)); 27.09 ($CH_2$(12), $CH_2$(13)); 29.08 ($CH_2$(8), $CH_2$(17)); 31.00 ($CH_2$(5), $CH_2$(20)); 34.64 ($CH_2$(9), $CH_2$(16)); 84.24 (CH(7), CH(18)); 84.60 (CH(11), CH(14)); 85.68 (CH(3), CH(22)); 71.67 (C(2), C(23)); 83.98 (C(10), C(15)); 85.61 (C(6), C(19)). FD-MS: 525 (100, $[M+H]^+$), 381 (25), 227 (29), 143 (27). FAB-MS (pos.): 525 (27, $[M+H]^+$), 507 (20, $[M+H-H_2O]^+$), 391 (23), 227 (31, $[M-C_{17}H_{29}O_3]^+$), 154 (100), 143 (54, $[M-C_{22}H_{37}O_4]^+$). HR-FAB-MS (pos.): 525.3782 ($[M+H]^+$, $C_{30}H_{53}O_7^+$; calc. 525.3792). Spectral data in agreement with those of the synthetic *meso* compound with a $C_s$ symmetry [5].

rel-*(2*R,*2′*S,*2″*S,*2‴*S,*2⁗*S,*5*S,*5′*R,*5″*R,*5‴*R,*5⁗*S*)-Eicosahydrooctamethyl-α⁵,α⁵,α⁵‴,α⁵⁗[2,2′:5′,2″:5″,2‴:5‴,2⁗:5⁗,2⁗⁗-quinquefuran]-5,5⁗-dimethanol* (**6**): Amorphous solids. $[\alpha]_D^{26} = +8.55$ ($c = 0.45$, $CHCl_3$). IR ($CHCl_3$): 3425, 1340, 1321, 1302, 1261, 1080, 1035, 958, 925, 901. $^1$H-NMR: 1.07 (*s*, 3 H); 1.11 (*s*, 3 H); 1.14 (br. *s*, 6 H); 1.15 (*s*, 3 H); 1.16 (*s*, 3 H); 1.20 (*s*, 3 H); 1.25 (*s*, 3 H); 1.42–1.50 (*m*, 1 H); 1.54–2.18 (*m*, 18 H); 2.24–2.40 (*m*, 1 H); 3.73–3.81 (*m*, 3 H); 3.85 (*dd*, *J* = 7.8, 5.6, 1 H); 3.92 (*dd*, *J* = 8.8, 6.1, 1 H); 4.03 (*dd*, *J* = 9.8, 5.9, 1 H). $^{13}$C-NMR: 22.40, 22.79, 23.83, 24.05, 25.09, 25.29, 27.67, 28.07 (8 Me); 26.46, 26.59, 27.38, 27.49, 29.23, 30.87, 34.07, 34.16, 34.27, 34.82 (10 $CH_2$); 83.96, 84.20, 84.27, 84.33, 85.72, 86.91 (6 CH); 70.63, 71.84, 84.66, 84.93, 85.72 (×2) (6 C). FAB-MS (pos.): 525 (44, $[M+H]^+$), 507 (22, $[M+H-H_2O]^+$), 307 (63), 289 (34), 227 (21, $[M-C_{17}H_{29}O_3]^+$), 154 (100), 143 (37, $[M-C_{22}H_{37}O_4]^+$). HR-FAB-MS (pos.): 525.3786 ($[M+H]^+$, $C_{30}H_{53}O_7^+$; calc. 525.3791).

*Acetylation of* **3** *into* **7**. To a soln. of **3** (7.0 mg) in $CH_2Cl_2$ (500 µl) were added $Ac_2O$ (200 µl) and DMAP (10.5 mg), and the mixture was stirred at r.t. for 3 days and then worked up as usual. The product obtained was subjected to TLC (hexane/AcOEt 9:1): *(α²*S,*2*R,*5*R*)-α²-[(2*E*)-3-[(2*R,*4a*R,*6*R,*8a*S*)-6-[(2*S,*5*R*)-5-bromotetrahydro-2,6,6-trimethyl-2*H*-pyran-2-yl]octahydro-8a-methylpyrano[3,2-*b*]pyran-2-yl}but-2-en-1-yl}-tetrahydro-α⁵,α⁵,2-trimethylfuran-2,5-dimethanol diacetate* (**7**; 2.2 mg). Amorphous solid. $[\alpha]_D^{21} = +3.4$ ($c = 0.22$, $CHCl_3$). HR-FAB-MS (pos.): 671.3149 ($[M+H]^+$, $C_{34}H_{56}^{79}BrO_8^+$; calc. 671.3159). Further spectral data ($^1$H- and $^{13}$C-NMR): in agreement with those of the authentic sample of 15,16-anhydrothyrsiferyl diacetate.

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