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Two New Cycloartane Glycosides from *Thalictrum thunbergii* D.C.

Hitoshi Yoshimitsu*, Makiko Nishida, Shoji Yahara# and Toshihiro Nohara#

Faculty of Engineering, Kyushu Kyoritsu University, 1-8 Jiyugaoka Yahata-nishi-ku, Kitakyushu 807, Japan

#Faculty of Pharmaceutical Sciences, Kumamoto University, 5-1 Oe-honmachi, Kumamoto 862, Japan

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Abstract: Two new cycloartane glycosides possessing a five-membered ring,which is constructed by a C-C bond, at the side chain have been isolated from the aerial parts of *Thalictrum thunbergii* D.C.

The genus *Thalictrum* plants grow widely in Japan. Thalictri Herba (dried whole plant of *Thalictrum* sp.) called Takatogusa has been used as a folk medicine for treating stomachdisorders in Nagano Prefecture. We previously reported the structural characterization of ten new cycloartane glycosides, thalictosides A and C[1] from the fresh aerial parts of *Thalictrum thunbergii* D.C. (Ranunculaceae) and thalictosides I, II, III, IV, V, IX, XII and XIII[2] from Thalictri Herba. In our extended search for cycloartane type glycosides, we have now isolated two cycloartane glycosides, named thalictosides D and E, from the dried aerial parts of *Thalictrum thunbergii* D.C.. This paper describes their structural elucidation. The water-soluble portion derived from the methanolic extract was separated by MCI gel CHP-20P, ODS and silica gel column chromatographies to give two new glycosides, designated thalictosides D (1) and E (2). Thalictoside D (1), a white powder, $[\alpha]_D$ -28.9° (MeOH), had a molecular formula $C_{60}H_{100}O_{28}$ based on elemental analysis and the positive FAB-MS (*m/z* 1291). The ^{1}H-NMR spectrum (pyridine-d_5) displayed an AB quartet signal at δ 0.32 and 0.85, which was characteristic of a cyclopropane methylene, five quaternary methyls at δ 1.24, 1.40, 1.43, 1.60 and 1.61, two secondary methyls at δ 1.65 (*J*=6.1 Hz) and 1.70 (*J*=6.1 Hz), five anomeric protons at δ 4.85 (1H, d, *J*=7.3 Hz), 5.01 (1H, d, *J*=7.3 Hz), 5.47 (1H, d, *J*=6.7 Hz), 5.49 (1H, br s) and 6.70 (1H, br s). The above ^{1}H-NMR data of **1** was similar to those of cycloartane glycosides from Thalictri Herba. A comparative study of the ^{13}C-NMR data of **1** with those of thalictosides III and IV indicated the presence of a diverse side chain. A sequence of connectivities through a methine proton at δ 2.89 (H-17), a methine proton at δ 2.27 (1H, dt, *J*=5.1, 7.2 Hz, H-20), a hydroxymethine proton at δ 4.22 (1H, dd, *J*=3.1, 7.4 Hz, H-22), methylene protons at δ 2.22 (1H, ddd, *J*=3.2, 9.2, 13.8 Hz, H-23α) and 2.68 (1H, br d, *J*=14.0 Hz, H-23β), a methine proton at δ 2.35 (1H, br d, *J*=11.6 Hz, H-24), a hydroxymethine proton at δ 4.82 (1H, br s, H-21) and a methine proton at δ 2.27 (H-20), in turn, was observed in the ^{1}H-^{1}H-COSY. Furthermore, the HMBC was observed between two singlet methyls (δ_H 1.40 and 1.61) and C-24 (δ_C 60.7). In addition, the NOESY was observed as shown in Fig. 1, suggesing the structure of a side chain for **1**. On acid hydrolysis **1** afforded D-glucose and L-rhamnose.[3] The ^{1}H-NMR and ^{13}C-NMR data[4] of **1**, which could be assigned by various NMR experiments,[5] showed signals due to the pentasaccharide moiety consisted of three glucopyranosyl moieties [δ 4.85 (d, *J*=7.3 Hz, H-1'), δ 5.01 (d, *J*=7.3 Hz, H-1''), δ 5.47 (d, *J* =6.7 Hz, H-1''')] and

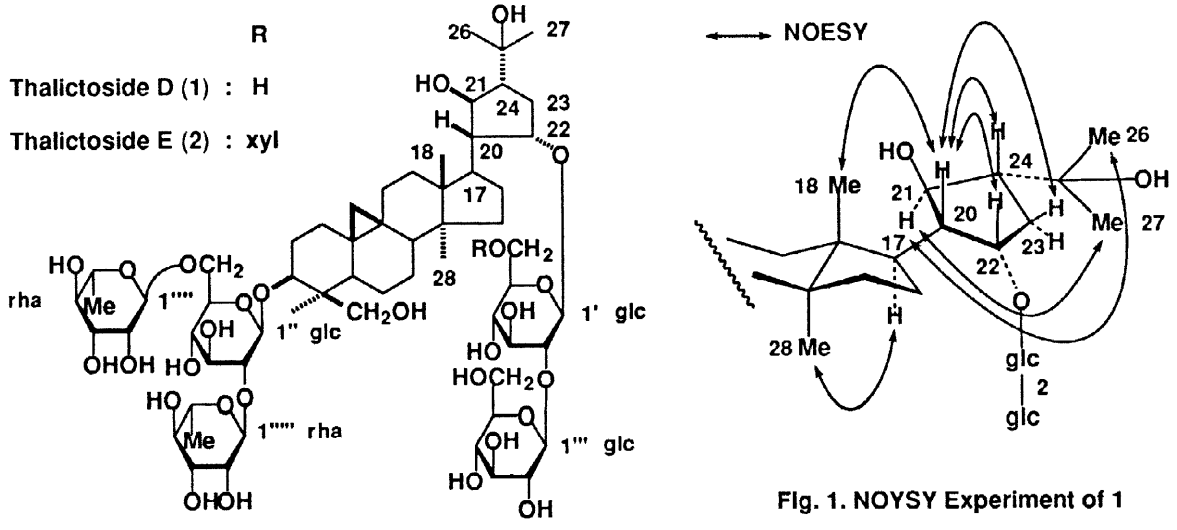

Fig. 1. NOYSY Experiment of 1

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two rhamnopyranosyl moieties [δ 5.49 (br s, H-1''''), δ 6.70 (br s, H-1'''')]. The HMBC experiment showed that the trisaccharide and the disaccharide moieties were linked to the C-3 and C-22 hydroxy groups of the aglycone, respectively. Moreover, long-range correlations were observed between the H-1'' of the glucopyranosyl moiety and the C-3 of the aglycone, between the H-1'''' of the rhamnopyranosyl moiety and the C-2'' of the glucopyranosyl moiety, between the H-1''' of the rhamnopyranosyl moiety and the C-6'' of the glucopyranosyl moiety, between the H-1' of the glucopyranosyl moiety and the C-22 of the aglycone and between the H-1''' of the glucopyranosyl moiety and the C-2' of the glucopyranosyl moiety. From the above evidence, the structure of **1** was concluded to be 22-*O*-β-D-glucopyranosyl-(1 → 2)-β-D-glucopyranosyl 20*R*,21*R*,22*S*,24*R*-cycloartane-3β,21,22,25,30-pentaol 3-*O*-α-L-rhamnopyranosyl-(1 → 2)-[α-L-rhamnopyranosyl-(1 → 6)]-β-D-glucopyranoside. Thalictoside E (**2**) obtained as a white powder, $[\alpha]_D$ -29.6° (MeOH), showed an AB quartet signal at δ 0.32 and 0.85, five singlet methyls at δ 1.23, 1.40, 1.45, 1.59 and 1.60, two secondary methyls at δ 1.65 and 1.72, six anomeric protons at δ 4.76, 5.00, 5.01, 5.41, 5.48 and 6.68 in the ^{1}H-NMR spectrum. Based on the above evidence, the structure of **2** was considered to be analogous to that of **1**. In the ^{13}C-NMR data of **2**, the signals due to the aglycone moiety were also in good agreement with those of **1**, although the signals due to the sugar moiety were not identical. Meanwhile, a molecular formula $C_{65}H_{108}O_{32}$ was higher by $C_5H_8O_4$ than that of **1**. On acid hydrolysis **2** afforded D-glucose, D-xylose and L-rhamnose. The ^{1}H-NMR and ^{13}C-NMR data[6] of **2**, which were assigned by various NMR experiments,[5] showed signals due to the hexasaccharide moiety consisted of three glucopyranosyl moieties [δ 4.76 (d, *J*=7.9 Hz, H-1'), δ 5.01 (d, *J*=7.3 Hz, H-1''), δ 5.41 (d, *J*=7.3 Hz, H-1''')], a xylopyranosyl moiety [δ 5.00 (d, *J*=7.9 Hz, H-1'''')] and two rhamnopyranosyl moieties [δ 5.48 (br s, H-1''''), δ 6.68 (br s, H-1'''')]. The HMBC experiment of **2** showed the same result as that of **1** except long-range correlations between H-1'''' of the xylopyranosyl moiety and the C-6' of the glucopyranosyl moiety linked to the C-22 hydroxy group of the aglycone. Consequently, the structure of **2** was determined to be 22-*O*-β-D-glucopyranosyl-(1 → 2)-[β-D-xylopyranosyl-(1 → 6)]-β-D-glucopyranosyl 20*R*,21*R*,22*S*,24*R*-cycloartane-3β,21,22,25,30-pentaol 3-*O*-α-L-rhamnopyranosyl-(1 → 2)-[α-L-rhamnopyranosyl-(1 → 6)]-β-D-glucopyranoside. They are novel cycloartane glycosides having structural peculiarities namely, a C-C bond between 21 and 24 and bisdesmosides at C-3 and C-22. The coexistent analogous[2] having a carbonyl group at C-21 and a double bond at Δ^{24} would cause a new C-C bond formation between C-21 and C-24.

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References and Note

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3. Hara, S.; Okabe, H.; Mihashi, K., *Chem. Pharm. Bull.*, **1987**, 35, 501.
4. ^{13}C-NMR spectra of **1** (in pyridine-d_5) δ : C-1,32.4; C-2,30.0; C-3,90.0; C-4,45.4; C-5,48.7; C-6,22.9; C-7,27.4; C-8,48.8; C-9,19.9; C-10,26.5; C-11,26.7; C-12,30.8; C-13,45.7; C-14,48.8; C-15,36.1; C-16,28.1; C-17,45.7; C-18,18.9 (1.43, s); C-19,31.2 (0.32, 0.85 each br s); C-20,57.3; C-21,77.4; C-22,86.7; C-23,34.5; C-24,60.7; C-25,71.1; C-26,29.2 (1.61, s); C-27,29.8 (1.40, s); C-28,21.2 (1.24, s); C-29,20.1 (1.60, s); C-30,60.8; C-1',103.1; C-2',81.5; C-3',78.6; C-4',71.6; C-5',78.6; C-6',63.0; C-1'',105.4; C-2'',76.3; C-3'',80.2; C-4'',72.1; C-5'',76.6; C-6'',68.6; C-1''',105.4; C-2''',75.5; C-3''',78.7; C-4''',71.9; C-5''',79.8; C-6''',63.9; C-1'''',102.7; C-2'''',72.2; C-3'''',72.9; C-4'''',73.9; C-5'''',69.8; C-6'''',18.7; C-1''''',101.0; C-2''''',72.3; C-3''''',72.4; C-4''''',74.5; C-5''''',69.2; C-6''''',18.5.
5. The ^{1}H-NMR and ^{13}C-NMR spectra were assigned with the aid of ^{1}H-^{1}H-COSY, HMQC, TOCSY and HMBC techniques.
6. ^{13}C-NMR spectra of **2** (in pyridine-d_5) δ : C-1,32.5; C-2,30.0; C-3,90.0; C-4,45.4; C-5,48.7; C-6,22.9; C-7,27.4; C-8,48.8; C-9,19.9; C-10,26.5; C-11,26.7; C-12,30.8; C-13,45.8; C-14,48.8; C-15,36.1; C-16,28.1; C-17,45.8; C-18,18.9 (1.45, s); C-19,31.2 (0.32, 0.85, each br s); C-20,57.2; C-21,77.5; C-22,86.8; C-23,34.7; C-24,60.4; C-25,71.2; C-26,29.2 (1.60, s); C-27,29.8 (1.40, s); C-28,21.2 (1.23, s); C-29,20.1 (1.59, s); C-30,60.9; C-1',103.1; C-2',81.3; C-3',78.6; C-4',71.2; C-5',77.3; C-6',68.9; C-1'',105.4; C-2'',76.4; C-3'',80.2; C-4'',72.1; C-5'',76.6; C-6'',68.6; C-1''',105.4; C-2''',75.5; C-3''',78.2; C-4''',71.9; C-5''',79.8; C-6''',63.9; C-1'''',102.7; C-2'''',72.3; C-3'''',72.9; C-4'''',73.9; C-5'''',69.8; C-6'''',18.7; C-1''''',101.0; C-2''''',72.3; C-3''''',72.4; C-4''''',74.5; C-5''''',69.2; C-6''''',18.5; C-1''''',105.9; C-2''''',75.0; C-3''''',78.2; C-4''''',71.2; C-5''''',67.2.