SYNTHESIS OF 3*β*,20*S*-DIHYDROXYDAMMAR-24-EN-12-ONE 3,20-DI-*O*-*β*-D-GLUCOPYRANOSIDE (CHIKUSETSUSAPONIN-LT$_8$), A GLYCOSIDE FROM *Panax japonicus*

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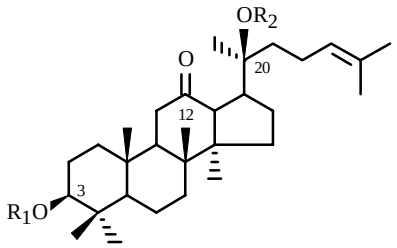
*A method for preparative production of 3*β*,20S-dihydroxydammar-24-en-12-one 3,20-di*-O-β-*D-glucopyranoside (**1**), a glycoside from* Panax japonicus, *chikusetsusaponin-LT$_8$ was developed. Chemical transformation of betulafolientriol, a component of* Betula *leaves extract, produced the 12-keto-20S-protopanaxadiol (3*β*,20S-dihydroxydammar-24-en-12-one) (**2**), exhaustive glycosylation of which by 2,3,4,6-tetra*-O-*acetyl-*α*-D-glucopyranosylbromide (**3**) under Koenigs—Knorr reaction conditions with subsequent removal of protecting groups formed 3*β*,20S-dihydroxydammar-24-en-12-one 3,20-di*-O-β-*D-glucopyranoside (**1**). The principal glycosylation product was 3*β*,20S-dihydroxydammar-24-en-12-one 3*-O-β-*D-glucopyranoside if equimolar amounts of (**2**) and (**3**) were used.*

Key words: dammarane triterpenoids, 12-keto-20*S*-protopanaxadiol, 3*β*-20*S*-dihydroxydammar-24-en-12-one, chikusetsusaponin-LT$_8$, *Betula*, *Panax japonicus*.

3*β*,20*S*-Dihydroxydammar-24-en-12-one 3,20-di-*O*-*β*-D-glucopyranoside (chikusetsusaponin-LT$_8$) (**1**) is a representative of rarely encountered natural glycosides, the aglycons of which are 12-keto-derivatives of 20*S*-protopanaxadiol (**2**) [1]. Changing the hydroxyl to a carbonyl in the aglycons of certain steroidal and triterpene glycosides changes their biological properties [2-5]. Dammarane tetracyclic triterpenoids and their glucosides, which have a ketone instead of a hydroxyl on C-3 in ring A or C-12 in ring C, are more cytotoxic *in vitro* toward GLC$_4$ carcinoma tumor cells and COLO 320 human adenocarcinoma than compounds that lack the ketone [6]. Furthermore, most keto derivatives of dammarane triterpenoids and their glucosides, which are more highly toxic toward tumor cells than other compounds, do not exhibit hemolytic properties [7, 8]. Therefore, the development of preparative methods for compounds that are increasingly toxic toward tumor cells but have a weaker hemolytic effect is certainly of interest.



1, 2, 7, 11 - 13

1: $R_1 = R_2 =$ Glc; **2:** $R_1 = R_2 = H$
7: $R_1 = R_2 =$ GlcAc$_4$; **11:** $R_1 =$ Ac, $R_2 = H$
12: $R_1 =$ GlcAc$_4$, $R_2 = H$; **13:** $R_1 =$ Glc, $R_2 = H$

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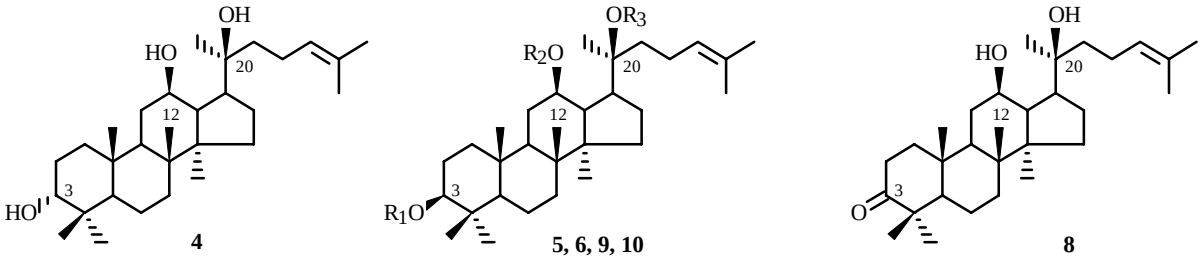
The structural similarty of the native genins of glycosides from *Panax ginseng* C. A. Meyer and *Panax japonicus* C. A. Meyer (ginsenosides and chikusetsusaponins) and tetracyclic dammarane triterpenoids, components of *Betula* leaves extracts, enables the latter to be used as relatively available starting materials for the semisynthetic preparation of natural glycosides, their metabolites, and compounds related to them. Herein we continue our research [9, 10] on the synthesis of glycosides based on tetracyclic dammarane triterpenoids for further study of their biological properties. The goal of the work was to develop a method for preparative production of 3β,20*S*-dihydroxydammar-24-en-12-one 3,20-di-*O*-β-D-glucopyranoside (**1**).

The simplest solution of this problem would seem to be oxidation of the C-12 hydroxyl in 20*S*-protopanaxadiol 3,20-diglucoside octaacetate (**6**) prepared previously by us [9]. Treatment of **6** under mild conditions with chromic anhydride in pyridine produced diglucoside octaacetate **7** in 66% yield. However, this method of preparing diglucoside **1** is unsuitable for preparative purposes because of the relatively low content of **6** in the mixture of products from condensation of 20*S*-protopanaxadiol **(5)** with acetobromoglucose (**3**) and the labor-intensive separation [9].

The method proposed by us for preparing **1** consists of chemical transformation of betulafolientriol (**4**) into the 12-ketone derivative of 20*S*-protopanaxadiol (3β,20*S*-dihydroxydammar-24-en-12-one) (**2**) and its exhaustive glycosylation by 2,3,4,6-tetra-*O*-acetyl-α-D-glucopyranosylbromide (α-acetobromoglucose) (**3**) followed by removal of protecting groups. Since betulafolientriol differs from **5** only by the configuration of the C-3 hydroxyl, the C-3 hydroxyl in triol **4** was first epimerized, for which **4** was oxidized by CrO_3 in pyridine to the 3-ketone **8** (65-70%), reduction of which by $NaBH_4$ in isopropyl alcohol formed **5** (83-85%). The C-12 hydroxyl in triol **5** was oxidized previously protecting the C-3 OH by acetylation.



5: $R_1 = R_2 = R_3 = H$; **6:** $R_1 = R_3 = GlcAc_4$, $R_2 = H$
9: $R_1 = Ac$, $R_2 = R_3 = H$; **10:** $R_1 = R_2 = Ac$, $R_3 = H$

The 3-*O*-acetyl derivative of 20*S*-protopanaxadiol **9** was prepared by partial deacetylation of 20*S*-protopanaxadiol diacetate **10** using MeONa in MeOH (83% yield). Treatment of **9** with CrO_3 in pyridine gave **11** (75% yield). Removal of the acetyl protecting group in **11** produced in quantitative yield the 12-ketone of 20*S*-protopanaxadiol (**2**). The 12-ketone **2** was condensed with α-acetobromoglucose (**3**) in the presence of Ag_2O and molecular sieves (4 Å) in dichloroethane at room temperature. Reaction of **2** with an excess of **3** formed diglucoside octaacetate **7** (63% yield). The principal glycosylation product if equimolar amounts of **2** and **3** were used was 3β,20*S*-dihydroxydammar-24-en-12-one 3-*O*-β-D-glucopyranoside tetraacetate (**12**) (38.6% yield). Deacetylation of **7** and **12** with MeONa (0.1 N) in MeOH gave in quantitative yields the corresponding free glucosides **1** and **13**.

Structures of all compounds were confirmed using IR, PMR, and ^{13}C NMR spectroscopy. A doublet for the C-3 anomeric sugar proton in the PMR spectra of **7** and **12** appeared at 4.53 ppm ($J_{1',2'}$ = 7.8 Hz); for the C-20 anomeric sugar proton of **7**, at 4.60 ppm ($J_{1',2'}$ = 7.8 Hz). Chemical shifts and spin—spin coupling constants of glucose anomeric protons are consistent with a *trans*-configuration of the glycoside bonds in diglucoside **7** and monoglucoside **12**. The site of attachment of the glucoses was established by comparing ^{13}C NMR spectra of **5**, **2**, and **6**, **7**, and **12** (Tables 1 and 2). Diglucoside **1** according to spectroscopy data, elemental analysis, and physicochemical properties was identified as natural chikusetsusaponin-LT_8, which was isolated previously from *Panax japonicus* leaves [1].

TABLE 1. ^{13}C Chemical Shifts for **1**, **2**, **5-7**, and **11-13** (δ, ppm, 0 = TMS)

C atom	Compound								
	1	**1** [1]	**2**	**5**	**6**	**7**	**11**	**12**	**13**
1	39.85	40.9	38.47	39.01	38.79	38.55	38.19	38.35	39.8
2	26.36	26.5	27.12	27.43	25.86	25.76	23.48	25.65	26.5
3	88.26	88.3	78.55	78.90	90.72	90.21	80.36	90.14	88.4
4	39.41	39.7	38.91	38.97	39.00	39.04	37.90	39.01	39.5
5	55.93	56.1	55.66	55.90	56.13	56.04	55.81	56.21	54.2
6	18.30	18.6	18.32	18.32	18.15	18.23	18.25	18.18	18.5
7	34.53	34.8	33.94	34.82	35.20	34.39	33.94	33.92	34.6
8	40.64	40.9	40.18	39.79	39.74	40.51	40.26	40.19	40.7
9	54.57	56.1	53.35	50.11	49.70	54.57	53.26	53.34	56.2
10	37.23	37.5	37.45	37.16	36.80	37.35	37.42	37.17	37.5
11	40.36	40.2	39.14	31.23	29.95	39.77	39.16	39.15	41.5
12	210.95	211.2	214.08	71.01	70.03	211.95	213.74	214.09	211.3
13	56.21	54.8	56.22	47.86	48.53	55.52	56.24	55.93	56.5
14	56.00	56.1	54.71	51.65	51.17	56.23	54.67	54.69	55.6
15	32.06	32.3	30.76	31.02	30.20	31.66	30.81	30.74	31.9
16	24.36	24.6	24.69	26.52	26.35	23.77	24.72	24.66	26.5
17	42.36	42.6	46.13	53.46	52.60	40.98	46.12	46.11	44.4
18	16.77	17.9	15.92	16.16	15.88[c]	15.55	15.96	15.91	16.0c
19	16.41	17.0	15.84	15.75	16.14[c]	16.06	15.92	15.75	15.8c
20	81.12	81.3	73.10	74.63	85.01	82.15	73.14	73.10	73.2
21	22.22	22.4	26.38	27.05	22.25	23.30	26.45	26.35	24.5
22	38.58	38.8	37.77	34.45	34.67	38.79	37.88	37.78	38.8
23	23.72	24.0	22.44	22.39	22.82	23.56	22.49	22.42	23.5
24	125.56	125.8	124.88	124.93	124.39	124.27	124.94	124.84	125.7
25	130.61	130.8	131.49	131.94	131.54	131.64	131.50	131.51	130.6
26	25.54	25.7	25.73	25.77	25.63	25.67	25.74	25.71	25.6
27	17.54	16.6	17.67	17.78	17.70	17.66	17.70	17.66	17.6
28	27.81	28.0	27.99	28.06	27.65	27.60	28.00	27.61	28.1
29	15.69	16.3	15.30	15.38	15.74	16.06	16.46	16.07	16.6
30	16.02	17.0	17.49	16.89	16.95	16.72	17.48	17.44	17.0
$\underline{CH_3}CO$					20.73	20.86	21.25	20.78	
$CH_3\underline{C}O$					20.68	20.82		20.70	
					20.61	20.74		20.62	
					20.61	20.66		20.62	
					20.61	20.66			
					20.61	20.66			
					20.61	20.66			
					20.55	20.66			
					170.63	170.67	170.84	170.60	
					170.63	170.67		170.34	
					170.38	170.39		169.42	
					170.36	170.27		169.13	
					169.39	169.60			
					169.30	169.46			
					169.11	169.18			
					168.96	169.07			

TABLE 2. ^{13}C Chemical Shifts for Sugars of **1**, **6**, **7**, **12**, and **13** (δ, ppm, 0 = TMS)

Compound	C atom					
	1′(3-Glc) 1″(20-Gc)	2′(3-Glc) 2″(20-Glc)	3′(3-Glc) 3″(20-Glc)	4′(3-Glc) 4″(20-Glc)	5′(3-Glc) 5″(20-Glc)	6′(3-Glc) 6″(20-Glc)
1	106.77	75.56	79.03	71.70	78.22	62.89
	98.27	75.50	78.54	71.70	77.79	62.77
1 lit. [1]	106.9	75.7	79.1	71.8	78.4	63.0
	98.4	75.7	78.6	71.8	77.9	63.0
6	102.93	71.68	72.96	68.83	72.10	62.36
	94.66	71.54	72.91	68.58	71.96	62.31
7	102.96	71.58	73.18	68.93	71.90	62.64
	94.57	71.53	72.81	68.71	71.62	62.23
12	102.93	71.58	72.81	68.72	71.63	62.24
13	106.4	75.6	78.5	71.9	77.9	63.1

EXPERIMENTAL

PMR and ^{13}C NMR spectra of **2**, **5**-**7**, **11**, and **12** were recorded on a Bruker AVANCE-500 spectrometer at working frequency 500 MHz for ^{1}H and 125 MHz for ^{13}C at 30°C in $CDCl_3$; of **1** and **13**, on a Bruker AVANCE-300 spectrometer at working frequency 300 MHz for ^{1}H and 75 MHz for ^{13}C in deuteropyridine. Chemical shifts are given on the δ scale relative to TMS. The multiplicity of the ^{13}C signals was found from standard DEPT-135 methods. Homonuclear 2D ^{1}H—^{1}H COSY-45 correlation spectra and heteronuclear 2D HSQC and HMBC correlation spectra were also obtained by standard methods. HMBC experiments were optimized for $^{n}J_{HC} \approx 10$ Hz. IR spectra were recorded on a Bruker Vector 22 spectrophotometer in $CHCl_3$ solution. Optical rotation was determined on a Perkin—Elmer 141 instrument in a 10-cm cuvette at 20°C. Melting points were measured on a Boetius stage. Column chromatography was performed over KSK silica gel (120-150 mesh) using the solvent systems benzene:methanol (200:1→60:1) and hexane:acetone (8:1→4:1). The purity of the compounds was monitored on TLC Sorbfil plates (Russia) using the solvent systems hexane:acetone (3:2) and benzene:chloroform:methanol (6:4:1, 3:2:1, 2:1:1) with development by H_2SO_4 (10%) in ethanol and heating at 100-200°C. Elemental analyses of all newly prepared compounds agreed with those calculated.

2,3,4,6-Tetra-*O*-acetyl-α-D-glucopyranosylbromide (α-acetobromoglucose) (**3**) was prepared by the literature method [11], mp 88°C (diethylether).

Betulafolientriol (3α,12β,20*S*-trihydroxydammar-24-ene) (**4**) was isolated from the unsaponified part of the ether extract of *Betula pendula* leaves, chromatographed over a column of silica gel, and crystallized from acetone, mp 195-196°C. Lit. [12] mp 197-198°C.

12β,20*S*-Dihydroxydammar-24-en-3-one (**8**) was prepared by oxidation of **4** by CrO_3 in pyridine as before [9, 10], mp 196-198°C (acetone).

20*S*-Protopanaxadiol (3β,12β,20*S*-trihydroxydammar-24-ene) (**5**) was isolated by reduction of **8** by $NaBH_4$ in isopropyl alcohol as described previously [9], mp 197-198°C (acetone).

3β,12β-Diacetoxy-20*S*-hydroxydammar-24-ene (**10**) was prepared by acetylation of **5** by acetic anhydride in pyridine at room temperature for 1 d as before [9], mp 172-173°C (acetone).

Deacetylation of Diacetate (10). A solution of **10** (2.06 g) in absolute MeOH (20 mL) was treated dropwise with MeONa in MeOH (1 mL, 1 N) and stirred at room temperature for 4 h (course of reaction monitored by TLC). The excess of MeONa was neutralized by cation exchanger KU-2 (H^+-form). Solvent was distilled off. The solid was chromatographed over a column with elution by hexane:acetone (20:1→8:1) to afford **10** (169 mg, 8.2%) and **9** (1.58 g, 83%).

3β-Acetoxy-12β,20*S*-dihydroxydammar-24-ene (**9**), mp 175-177°C (acetone). PMR spectrum (500 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.86 (6H, s, Me-28, Me-29), 0.88 (3H, s, Me-30), 0.91 (3H, s, Me-19), 0.99 (3H, s, Me-18), 1.19 (3H, s, Me-21),

1.63 (3H, s, Me-27), 1.69 (3H, s, Me-26), 2.04 (3H, s, OAc), 3.60 (1H, td, J = 10.5, 10.5, 5.2, H-12α), 4.48 (1H, dd, J = 10.7, 5.7, H-3α), 5.16 (1H, t, J = 7.0, 7.0, H-24).

Oxidation of Monoacetate (9). Chromic anhydride (CrO_3, 3 g) was added with stirring to absolute pyridine (30 mL). After the yellowish-orange complex formed, a solution of **9** (2.62 g) in pyridine (25 mL) was added dropwise with stirring at room temperature for 10 h. The completion of the reaction was monitored using TLC. The reaction mixture was diluted with $CHCl_3$ and passed through a layer of silica gel. The solvent was distilled off at reduced pressure. The solid was dried to constant weight (2.60 g) and chromatographed over a column of silica gel with elution by hexane:acetone (20:1) to afford **11** (2.15 g, 82.7%).

3β-Acetoxy-20*S*-hydroxydammar-24-en-12-one (11), $C_{32}H_{52}O_4$, amorph., $[\alpha]_D^{20}$ +49.9° (*c* 0.6, $CHCl_3$). IR spectrum (ν, cm^{-1}): 3416 (OH), 1722 (CH_3C=O), 1690 (C=O). PMR spectrum (500 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.80 (3H, s), 0.87 (3H, s), 0.88 (3H, s), 0.95 (3H, s), 1.12 (3H, s), 1.18 (3H, s), 1.62 (3H, s), 1.69 (3H, s), 2.05 (3H, s, OAc), 2.21 (1H, t, J = 13.6, 13.6, H-11β), 2.28 (1H, dd, J = 14.4, 4.5, H-11α), 2.40 (1H, td, J = 10.6, 10.6, 7.0, H-17), 2.85 (1H, d, J = 10.3, H-13), 4.48 (1H, dd, J = 11.6, 4.8, H-3α), 5.10 (1H, m, H-24).

3β,20*S*-Dihydroxydammar-24-en-12-one (2) was prepared by deacetylation of **11** by KOH (10%) in MeOH, $C_{30}H_{50}O_3$, mp 168-169°C (MeOH), $[\alpha]_D^{20}$ +49.8° (*c* 1.0, $CHCl_3$). IR spectrum (ν, cm^{-1}): 3608 (OH), 3416 (OH), 1690 (C=O). PMR spectrum (500 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.80 (3H, s, Me-30), 0.81 (3H, s, Me-29), 0.93 (3H, s, Me-19), 0.99 (3H, s, Me-28), 1.11 (3H, s, Me-21), 1.18 (3H, s, Me-18), 1.62 (3H, s, Me-27), 1.69 (3H, s, Me-26), 2.21 (1H, t, J = 14.2, 14.2, H-11β), 2.28 (1H, dd, J = 14.5, 4.6, H-11α), 2.40 (1H, td, J = 10.5, 10.5, 7.0, H-17), 2.86 (1H, d, J = 10.2, H-13), 3.20 (1H, dd, J = 11.5, 4.8, H-3α), 5.10 (1H, m, H-24).

3,20-Di-*O*-(2′,3′,4′,6′-tetra-*O*-acetyl-β-D-glucopyranosyl)dammar-24-en-3β,12β,20*S*-triol (6) was prepared as before [9], mp 120-125°C (hexane:acetone). PMR spectrum (500 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.74 (3H, s), 0.85 (3H, s), 0.86 (3H, s), 0.90 (3H, s), 0.96 (3H, s), 1.26 (3H, s), 1.60 (3H, s), 1.67 (3H, s), 2.00 (3H, s, OAc), 2.01 (3H, s, OAc), 2.02 (3H, s, OAc), 2.02 (3H, s, OAc), 2.03 (3H, s, OAc), 2.04 (3H, s, OAc), 2.05 (3H, s, OAc), 2.08 (3H, s, OAc), 3.07 (1H, dd, J = 11.6, 4.8, H-3α), 3.53 (1H, td, J = 10.1, 10.1, 5.8, H-12α), 3.68 (2H, m, H-5′, H-5″), 4.11 (3H, m, H-6′, 2H-6″), 4.26 (1H, dd, J = 12.1, 5.8, H-6′, C-3), 4.53 (1H, d, $J_{1',2'}$ = 7.8, H-1′ of glucose C-3), 4.86 (1H, d, $J_{1'',2''}$ = 7.8, H-1″ of glucose C-20), 4.90 (1H, dd, J = 9.3, 7.8, H-2″ of glucose C-20), 5.02 (3H, m, H-2′, H-4′, H-4″), 5.08 (1H, m, H-24), 5.20 (1H, t, J = 9.6, 9.6, H-3″ of glucose C-20), 5.23 (1H, t, J = 9.3, 9.3, H-3′ of glucose C-3).

Oxidation of Diglucoside 6. Chromic anhydride (500 mg) was added to cold absolute pyridine (5 mL) with stirring. After the yellowish-orange complex formed, **6** (150 mg) in absolute pyridine (2 mL) was added dropwise with stirring at room temperature for 10 h. The completeness of the reaction was monitored by TLC. The reaction mixture was diluted with $CHCl_3$ and passed over a layer of silica gel. The solvent was distilled at reduced pressure. The solid was dried to constant weight. The dry solid (139 mg) was crystallized from MeOH to afford crystalline **7** (100 mg, 66.3%).

3,20-Di-*O*-(2′,3′,4′,6′-tetra-*O*-acetyl-β-D-glucopyranosyl)-3β,20*S*-dihydroxydammar-24-en-12-one (7), $C_{58}H_{86}O_{21}$, mp 232-234°C (MeOH), $[\alpha]_D^{20}$ +11° (*c* 1.0, $CHCl_3$). IR spectrum (ν, cm^{-1}): 1755 (CH_3C=O), 1704 (C=O). PMR spectrum (500 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.72 (3H, s, Me-30), 0.76 (3H, s, Me-29), 0.91 (3H, s, Me-28), 0.93 (3H, s, Me-19), 1.03 (3H, s, Me-21), 1.19 (3H, s, Me-18), 1.61 (3H, s, Me-27), 1.66 (3H, s, Me-26), 1.98 (3H, s, OAc), 1.99 (3H, s, OAc), 2.00 (3H, s, OAc), 2.02 (6H, s, 2OAc), 2.03 (3H, s, OAc), 2.05 (3H, s, OAc), 2.08 (3H, s, OAc), 2.45 (1H, td, J = 10.4, 10.4, 5.5, H-17), 3.01 (1H, d, J = 9.5, H-13), 3.06 (1H, dd, J = 11.8, 4.6, H-3α), 3.67 (2H, m, H-5′, H-5″), 4.08 (1H, dd, J = 12.1, 2.6, H-6″ of glucose C-20), 4.11 (1H, dd, J = 12.1, 2.6, H-6′ of glucose C-3), 4.16 (1H, dd, J = 11.9, 6.8, H-6″ of glucose C-20), 4.24 (1H, dd, J = 12.2, 5.6, H-6′ of glucose C-3), 4.53 (1H, d, J = 7.8, H-1′ of glucose C-3), 4.60 (1H, d, J = 7.8, H-1″ of glucose C-20), 4.93 (1H, dd, J = 9.5, 7.8, H-2″ of glucose C-20), 4.98 (1H, t, J = 9.8, 9.8, H-4″ of glucose C-20), 5.02 (1H, dd, J = 9.6, 8.1, H-2′ of glucose C-3), 5.03 (1H, t, J = 9.8, 9.8, H-4′ of glucose C-3), 5.04 (1H, t, J = 6.3, 6.3, H-24), 5.18 (1H, t, J = 9.3, 9.3, H-3″ of glucose C-20), 5.20 (1H, t, J 9.3, 9.3, H-3′ of glucose C-3).

Condensation of 2 with 2,3,4,6-Tetra-*O*-acetyl-α-D-glucopyranosylbromide (3) in the Presence of Ag_2O and Molecular Sieves (4 Å).

Experiment 1. A mixture of **2** (1.24 g, 2.7 mmol), Ag_2O (1.17 g, 5 mmol), mol. sieves (1 g, 4 Å), and **3** (2.06 g, 5 mmol) in absolute CH_2Cl_2 (25 mL) was stirred at room temperature until **3** disappeared (TLC monitoring). The mixture was treated in two portions with more Ag_2O (2.34 g, 10 mmol) and **3** (4.11 g, 10 mmol), stirred for 6 h until **2** and **3** disappeared, diluted with $CHCl_3$, and filtered to remove insoluble silver compounds and molecular sieves. The solvent was removed in vacuo.

The solid was chromatographed over a column of silica gel with elution by hexane:acetone mixtures (10:1→4:1) to afford **7** (1.91 g, 63.2%).

Experiment 2. A mixture of **2** (853 mg, 1.86 mmol), Ag_2O (436 mg, 1.86 mmol), **3** (765 mg, 1.86 mmol), and molecular sieves (1g, 4 Å) in absolute CH_2Cl_2 (15 mL) was stirred at room temperature (20-22°C) until **3** disappeared completely (TLC monitoring). The mixture was worked up as above. Column chromatography afforded **2** (360 mg, 42.2%), **12** (565 mg, 38.6%), and **7** (265 mg, 12.8%).

3-*O*-(2′,3′,4′,6′-Tetra-*O*-acetyl-*β*-D-glucopyranosyl)-3*β*,20*S*-dihydroxydammar-24-en-12-one (12), $C_{44}H_{68}O_{12}$, mp 135-138°C (EtOH), $[\alpha]_D^{20}$ +23° (*c* 1.0, $CHCl_3$). IR spectrum (ν, cm^{-1}): 3411 (OH), 1756 (CH_3C=O), 1689 (C=O),. PMR spectrum (500 MHz, $CDCl_3$, δ, ppm, J/Hz): 0.76 (3H, s, Me-29), 0.78 (3H, s, Me-30), 0.92 (6H, s, Me-28, Me-19), 1.11 (3H, s, Me-21), 1.17 (3H, s, Me-18), 1.61 (3H, s, Me-27), 1.68 (3H, s, Me-26), 2.00 (3H, s, OAc), 2.02 (3H, s, OAc), 2.03 (3H, s, OAc), 2.08 (3H, s, OAc), 2.21 (1H, t, J = 13.8, 13.8, H-11*β*), 2.27 (1H, dd, J = 14.3, 4.7, H-11*α*), 2.39 (1H, td, J = 10.4, 10.4, 7.0, H-17), 2.85 (1H, d, J = 10.4, H-13), 3.06 (1H, dd, J = 11.9, 4.7, H-3*α*), 3.67 (1H, ddd, J = 10.1, 5.5, 2.6, H-5′), 4.11 (1H, dd, J = 12.2, 2.6, H-6′), 4.24 (1H, dd, J = 12.2, 5.7, H-6′), 4.53 (1H, d, J = 8.0, H-1′), 5.02 (1H, J = 9.8, 8.0, H-2′), 5.03 (1H, t, J = 9.6, 9.6, H-4′), 5.09 (1H, t, J = 7.0, 7.0, H-24), 5.20 (1H, t, J = 9.6, 9.6, H-3′).

Glucosides **7** and **12** were deacetylated by MeONa in MeOH (0.1 N) at room temperature for 1-2 h.

3,20-Di-*O*-*β*-D-glucopyranosyl-3*β*,20*S*-dihydroxydammar-24-en-12-one (1), $C_{42}H_{70}O_{13}\cdot 2H_2O$, mp 243-248°C (MeOH), $[\alpha]_D^{20}$ +14.3° (*c* 1.0, pyridine).

3-*O*-*β*-D-Glucopyranosyl-3*β*,20*S*-hydroxydammar-24-en-12-one (13), $C_{36}H_{60}O_8$, mp 195-200°C (dec.) (MeOH), $[\alpha]_D^{20}$ +25.0° (*c* 1.0, pyridine).

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