Carbohydrate Research, 189 (1989) 323–330
Elsevier Science Publishers B.V., Amsterdam – Printed in The Netherlands

Note

Synthesis of the penta-*N,O*-acetyl derivatives of some pseudo-3-amino-3-deoxy-DL-hexopyranoses and -DL-hexopyranosylamine derivatives*

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(Received October 3rd, 1988; accepted for publication, December 3rd, 1988)

In continuation of previous work[2], the synthesis of the penta-*N,O*-acetyl derivatives of three pseudo-3-amino-3-deoxy-DL-hexopyranoses with α- and β-*gluco*, and β-*manno* configurations is described. Only pseudo-3-amino-3-deoxy-β-DL-altro- and -α-DL-ido-pyranose derivatives are known[3]; the corresponding normal sugar, 3-amino-3-deoxy-D-glucopyranose (kanosamine) is a constituent of kanamycin[4] and hikijimycin[5], and is produced[6] by *Bacillus aminoglucosidics*.

1-*O*-Acetyl-pseudo-α-DL-galactopyranose (**2**) was prepared (82%) by acid hydrolysis of the known[7] di-*O*-isopropylidene derivative **1**. Treatment of **2** with 3.5 mol of sodium metaperiodate in water gave the dialdehyde **8**, which was subjected to nitromethane-cyclisation in methanolic sodium methoxide at room temperature. T.l.c. showed that more than three products appeared rapidly. Under thermodynamically controlled conditions (after 5 h), there were one major and one minor component. Further reaction gradually gave slower-moving components. Column chromatography of the mixture of products gave 61% (based on **2**) of the major nitrotetrol **9**. Hydrogenation of **9** over Raney nickel T-4[8] and acetylation of the product gave the crystalline penta-*N,O*-acetyl derivative (**10**, 87%) of a pseudo-3-amino-3-deoxyhexopyranose. The 400-MHz ^{1}H-n.m.r. spectrum ($CDCl_3$) of **10** contained signals at δ 5.37 (q, J 2.9 Hz), 4.83 (dd, J 2.9 and 11.2 Hz), 4.81 (t, J 10.7 Hz), and 4.57 (bq, J ~11 Hz), attributable to H-1,2,4,3, respectively, supporting the α-*gluco* configuration.

The 2-epimeric dialdehyde (**11**) of **8** was generated from the tetrol **6** obtained by acid hydrolysis of the known[7] di-*O*-isopropylidene derivative **4**. Cyclisation of **11** with nitromethane gave, after 1.5 h, three products, of which only the major compound **12** was isolated (13%) with difficulty by chromatography on silica gel. When the mixture of nitrotetrols was hydrogenated and then acetylated, column

*Pseudo-sugars, Part XXIII. For Part XXII, see ref. 1.

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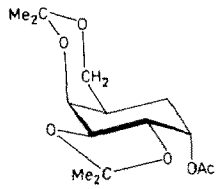

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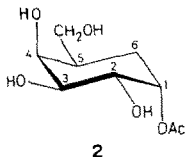

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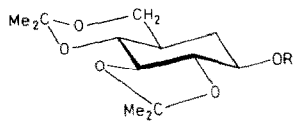
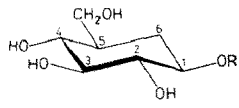
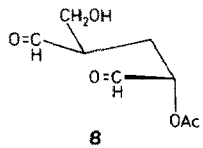


3 R = H
4 R = Ac
5 R = Bzl



6 R = Ac
7 R = Bzl



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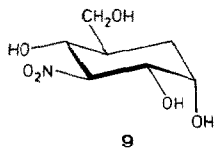

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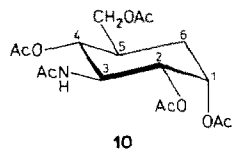
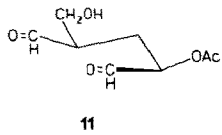
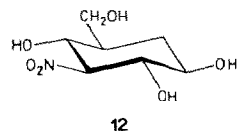


10

chromatography of the resulting penta-*N,O*-acetyl derivatives gave **10** (6%), **13** (19%), and **14** (6%), each of which was crystalline. Hydrogenation of **12** followed by acetylation afforded **13** (90%). The ^{1}H-n.m.r. spectrum of **13** contained signals at δ 4.96 (td, J 4.9, 9.8, and 9.8 Hz), 4.92 (t, J 9.8 Hz), 4.80 (t, J 10.8 Hz), and 4.25 (bq, J 10 Hz), due to H-1,2,4,3, respectively, indicating the *β-gluco* configuration. The spectrum of **14** contained signals at δ 5.47 (dd, J 2.9 Hz), 4.97 (t, J 10.7 Hz), 4.96 (ddd, J 2.9, 4.5, and 12.2 Hz), and 4.30 (ddd, J 2.9, 8.8, and 10.7 Hz), ascribable to H-2,4,1,3, respectively, and indicative of the *β-manno* configuration. The formation of **10** may be explained, at least in part, by epimerisation of **11** at C-2 under the basic conditions.



11



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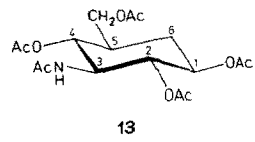

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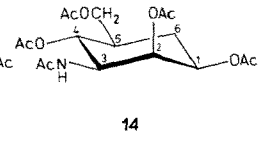

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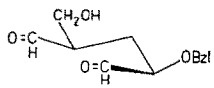
In order to suppress the epimerisation of the intermediates, the 1-*O*-benzyl derivative **5** was prepared from the known[7] alcohol **3**. The dialdehyde, **15**, from **5** was treated with nitromethane in methanol–water (1:1) in the presence of sodium hydrogencarbonate at room temperature. The reaction proceeded slowly, but the selectivity was improved. After 70 h, one major and three minor products were detected. The mixture of nitrotriols obtained was hydrogenated in methanol containing acetic anhydride, and the major product was acetylated to give the crystalline tetra-*N,O*-acetyl derivative **16** (40% based on **5**). Hydrogenolysis of **16** followed by acetylation gave 97% of **13**.

The preparation of 3-amino-3-deoxy derivatives of pseudo-α-gluco-pyranosylamine (validamine) was investigated next. The dialdehyde generated from *N*-acetyl-DL-validamine (**18**), derived by *O*-deacetylation of the penta-*N,O*-acetyl derivative[9–11] **17**, was coupled with nitromethane in water in the presence of

sodium hydrogencarbonate to give 79% of a mixture of the nitrotriols, from which 47% of the penta-*N,O*-acetyl derivative of 3-amino-3-deoxy-DL-validamine (**21**) was obtained after hydrogenation and acetylation. Similarly, the di-*N*-acetyl derivative **20**, derived from the penta-*N,O*-acetyl derivative of 7-amino-7-deoxy-DL-validamine[10,11] (**19**), was converted into the dialdehyde, which reacted with nitromethane to give, after hydrogenation and acetylation, 51% of the penta-*N,O*-acetyl derivative of 3,7-diamino-3,7-dideoxy-DL-validamine (**22**). The ^{1}H-n.m.r. spectra of **21** and **22** accorded with the structures assigned.



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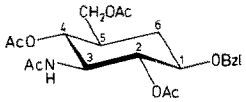

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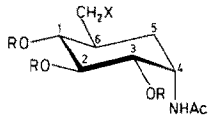
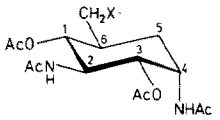


	R	X
17	Ac	OAc
18	H	OH
19	Ac	NHAc
20	H	NHAc



21 X = OAc
22 X = NHAc

EXPERIMENTAL

General methods. — Melting points were determined with a MEL-TEMP capillary apparatus and are uncorrected. Unless otherwise stated, ^{1}H-n.m.r. spectra were recorded at 90 MHz with a Varian EM-390 spectrometer for solutions in $CDCl_3$ (internal Me_4Si). The spectra at 270 MHz and 400 MHz were recorded with Jeol GSX-270 and GX-400 spectrometers. T.l.c. was performed on Silica Gel G-254 (Merck) with detection by charring with sulfuric acid. Column chromatography was conducted on Wakogel C-300 (300 Mesh, Wako Co., Osaka). Organic solutions were dried over anhydrous Na_2SO_4, and concentrated at <50° under diminished pressure.

DL-*(1,2/3,4,5)-1*-O-*Acetyl-5-hydroxymethyl-1,2,3,4-cyclohexanetetrol* (**2**). — (1*RS*,2*RS*,7*SR*,9*RS*,10*RS*)-9-Acetoxy-4,4,12,12-tetramethyl-3,5,11,13-tetraoxatricyclo[8.3.0.0^{3,8}]tridecane (1-*O*-acetyl-2,3:4,7-di-*O*-isopropylidene-pseudo-α-DL-galactopyranose) (**1**; 252 mg, 0.84 mmol) was treated with aqueous 80% acetic acid (5 mL) for 5 h at room temperature. The mixture was concentrated and the residue was crystallised from ethanol to give **2** (151 mg, 82%) as needles, m.p. 131–133°. ^{1}H-N.m.r. data (CD_3OD): δ 4.87 (q, 1 H, $J_{1,2} = J_{1,6a} = J_{1,6e}$ = 3.1 Hz, H-1), 1.97 (s, 3 H, OAc).

Anal. Calc. for $C_9H_{16}O_6$: C, 49,09; H, 7.32. Found: C, 49.24; H, 7.15.

DL-*(1,2,4/3,5)-5-Hydroxymethyl-3-nitro-1,2,4-cyclohexanetriol* (**9**). — To a cooled solution of **2** (150 mg, 0.68 mmol) in water (7 mL) was added a solution of sodium metaperiodate (0.51 g, 2.38 mmol) in water (3.5 mL). The mixture was kept slightly alkaline by the addition of sodium hydrogencarbonate. After 2 h at 20–25°, ethanol (20 mL) was added, the precipitate was removed, the filtrate was

concentrated, and the residue was extracted with ethyl acetate (20 mL) to give the dialdehyde **8** as a syrup that was used without purification. A solution of **8** in methanol (5 mL) was treated with nitromethane (0.11 mL, 2.1 mmol) and methanolic M sodium methoxide (0.52 mL) for 5 h at 20–25°. T.l.c. [chloroform–methanol (5:1)] revealed components with R_F 0.50 (major) and 0.49. The mixture was neutralised with Amberlite IR-120B (H^+) resin and concentrated, and the residue was eluted from a column of silica gel with chloroform–methanol (7:1), to give **9** (86 mg, 61%) as a syrup. An analytical sample, prepared by drying over P_2O_5 at 100° under vacuum, absorbed water rapidly.

Anal. Calc. for $C_7H_{13}NO_6 \cdot 0.5\ H_2O$: C, 38.89; H, 6.53; N, 6.48. Found: C, 38.58; H, 6.17; N, 6.27.

DL-*(1,2,4/3,5)-3-Acetamido-5-acetoxymethyl-1,2,4-tri-*O*-acetyl-1,2,4-cyclohexanetriol* (**10**). — A solution of **9** (74 mg, 0.36 mmol) in methanol (5 mL) was hydrogenated in the presence of acetic anhydride (34 μL, 0.36 mmol) and Raney nickel T-4 (0.2 mL) at an initial hydrogen pressure of 50 p.s.i. (Parr apparatus) for 15 h. The catalyst was then removed, the filtrate was concentrated, the residue was treated with acetic anhydride (1 mL) and pyridine (1 mL), and the product was eluted from a column of silica gel with ethanol–toluene (1:7), to give **10** (120 mg, 87%) as needles, m.p. 146.5–148° (from ethanol). ^{1}H-N.m.r. data (400 MHz): δ 5.43 (d, 1 H, $J_{3,NH}$ 10.3 Hz, NH), 5.37 (q, 1 H, $J_{1,2} = J_{1,6a} = J_{1,6e}$ = 2.9 Hz, H-1), 4.83 (dd, 1 H, $J_{2,3}$ 11.2 Hz, H-2), 4.81 (t, 1 H, $J_{3,4} = J_{4,5}$ = 10.7 Hz, H-4), 4.57 (q, 1 H, H-3), 4.20 (dd, 1 H, $J_{5,7}$ 4.4, $J_{7,7}$ 11.2 Hz, H-7), 3.89 (dd, 1 H, $J_{5,7'}$ 2.9 Hz, H-7′), 2.40–2.33 (m, 1 H, H-6*e*), 2.15, 2.06, 2.05, 2.02, and 1.90 (5 s, each 3 H, NAc and 4 OAc).

Anal. Calc. for $C_{17}H_{25}NO_4$: C, 52.71; H, 6.51; N, 3.62. Found: C, 52.65; H, 6.43; N, 3.55.

DL-*(1,3,5/2,4)-1-*O*-Acetyl-5-hydroxymethyl-1,2,3,4-cyclohexantetrol* (**6**). — (1*SR*,2*RS*,7*RS*,9*RS*,10*SR*)-9-Acetoxy-4,4,12,12-tetramethyl-3,5,11,13-tetraoxatricyclo[8.3.0.0^{2,7}]tridecane (1-*O*-acetyl-2,3:4,7-di-*O*-isopropylidene-pseudo-β-DL-glucopyranose) (**4**; 366 mg, 1.22 mmol) was treated with aqueous 80% acetic acid (15 mL) for 3 h at room temperature. The mixture was concentrated and the residue was eluted from a column of silica gel with chloroform–methanol (8:1), to give **6** (268 mg, ~100%) as a syrup. ^{1}H-N.m.r. data (CD_3OD): δ 5.60–5.33 (m, 1 H, H-1), 2.00 (s, 3 H, OAc).

Anal. Calc. for $C_9H_{16}O_6$: C, 49.09; H, 7.32. Found: C, 48.78; H, 7.00.

DL-*(1,3,5/2,4)-5-Hydroxymethyl-3-nitro-1,2,4-cyclohexanetriol* (**12**). — Compound **6** (884 mg, 4.0 mmol) was converted into the dialdehyde (**11**) as described in the preparation of **8**. A solution of **11** in methanol (30 mL) was treated with nitromethane (0.65 mL, 12.0 mmol) and methanolic M sodium methoxide (3.1 mL) for 1.5 h at room temperature, then processed in the usual way. The products were eluted from a column of silica gel with chloroform–methanol (8:1), to give **12** (110 mg, 13%) as plates, m.p. 149° (dec.) (from ether).

Anal. Calc. for $C_7H_{13}NO_6$: C, 40.58; H, 6.32; N, 6.76. Found: C, 40.17; H, 6.00; N, 6.65.

The other nitrotetrols were obtained as an inseparable mixture (~280 mg, 34%).

DL-*(1,3,5/2,4)-3-Acetamido-5-acetoxymethyl-1,2,4-tri*-O-*acetyl-1,2,4-cyclohexanetriol* (**13**). — Compound **12** (110 mg, 0.53 mmol) was hydrogenated and the product was acetylated as described in the preparation of **10**. The product crystallised from ethanol to give **13** (185 mg, 90%) as needles, m.p. 146.5–148°. ^{1}H-n.m.r. data (400 MHz): δ 5.54 (d, 1 H, $J_{3,NH}$ 9.8 Hz, NH), 4.96 (td, 1 H, $J_{1,2} = J_{1,6a} = 9.8$, $J_{1,6e}$ 4.9 Hz, H-1), 4.92 (t, 1 H, $J_{2,3}$ 9.8 Hz, H-2), 4.80 (t, 1 H, $J_{3,4} = J_{4,5} = 10.8$ Hz, H-4), 4.25 (q, 1 H, H-3), 4.13 (dd, 1 H, $J_{5,7}$ 5.2, $J_{7,7}$ 11.5 Hz, H-7), 3.94 (dd, 1 H, $J_{5,7'}$ 2.9 Hz, H-7'), 2.25 (td, 1 H, $J_{1,6e} = J_{5,6e} = 4.9$, $J_{6,6}$ 12.7 Hz, H-6*e*), 2.05, 2.04, 2.03, and 1.89 (4 s, 6, 3, 3, and 3 H, NAc and 4 OAc), 1.49 (dt, 1 H, $J_{1,6a} = J_{5,6a} = 9.8$ Hz, H-6*a*).

Anal. Calc. for $C_{17}H_{25}NO_7$: C, 52.71; H, 6.51; N, 3.62. Found: C, 52.64; H, 6.40; N, 3.71.

DL-*(1,2,3,5/4)-3-Acetamido-5-acetoxymethyl-1,2,4-tri*-O-*acetyl-1,2,4-cyclohexanetriol* (**14**). — The mixture of nitrotetrols obtained from **6** (884 mg, 4.0 mmol) was hydrogenated and then acetylated as described in the preparation of **10**, and the products were fractionated on a column of silica gel with ethanol–toluene (1:10) and then with ethyl acetate–petroleum ether–tetrahydrofuran (2:2:1), to give **10** (100 mg, 6%), **13** (300 mg, 19%), and **14** (92 mg, 6%) as plates, m.p. 154–156° (from ethanol). ^{1}H-N.m.r. data (400 MHz) for **14**: δ 5.64 (d, 1 H, $J_{3,NH}$ 8.8 Hz, NH), 5.47 (dd, 1 H, $J_{1,2} = J_{2,3} = 2.9$ Hz, H-2), 4.97 (t, 1 H, $J_{3,4} = J_{4,5} = 10.7$ Hz, H-4), 4.96 (ddd, 1 H, $J_{1,6a}$ 12.2, $J_{1,6e}$ 4.5 Hz, H-1), 4.30 (ddd, 1 H, $J_{3,4}$ 10.7 Hz, H-3), 4.13 (dd, 1 H, $J_{5,7}$ 5.9, $J_{7,7}$ 11.2 Hz, H-7), 4.00 (dd, 1 H, $J_{5,7'}$ 3.4 Hz, H-7'), 2.20, 2.07, 1.98, and 1.91 (4 s, 3, 6, 3, and 3 H, NAc and 4 OAc).

Anal. Calc. for $C_{17}H_{25}NO_4$: C, 52.71; H, 6.51; N, 3.62. Found: C, 52.74; H, 6.44; N, 3.62.

DL-*(1,3,5/2,4)-1*-O-*Benzyl-5-hydroxymethyl-1,2,3,4-cyclohexanetetrol* (**7**). — (1*SR*,2*RS*,7*RS*,9*RS*,10*SR*)-4,4,12,12-Tetramethyl-3,5,11,13-tetraoxatricyclo[8.3.-0.0^{2,7}]trideca-9-ol (2,3:4,7-di-*O*-isopropylidene-pseudo-β-DL-glucopyranose) (**3**; 600 mg, 2.32 mmol) was treated with 60% sodium hydride (280 mg, 6.98 mmol) in *N,N*-dimethylformamide (10 mL) for 30 min at 0–5°. Benzyl bromide (0.83 mL, 6.98 mmol) was then added and the mixture was stirred for 2 h at room temperature. After the addition of methanol, the mixture was concentrated, the residue was extracted with ethyl acetate, and the extract was washed with water, dried, and concentrated. The residue was eluted from a column of silica gel with 2-butanone–toluene (1:15), to give 5-*O*-benzyl-2,3:4,7-di-*O*-isopropylidene-pseudo-β-DL-glucopyranose (**5**; 808 mg, ~100%) as needles, m.p. 124–125.5° (from ethanol). ^{1}H-N.m.r. data: δ 7.33–7.00 (m, 5 H, Ph), 4.67 and 4.47 (2 d, each 1 H, J_{gem} 12.6 Hz, CH_2Ph), 3.83–3.27 (m, 6 H, H-1,2,3,4,7,7'), 1.40 and 1.39 (2 s, each 6 H, 2 CMe_2).

Anal. Calc. for $C_{20}H_{28}O_5$: C, 68.94; H, 8.10. Found: C, 68.59; H, 7.93.

A solution of **5** (0.80 g, 2.3 mmol) in methanol (20 mL) containing *p*-toluenesulfonic acid monohydrate (10 mg) was kept for 2 h at room temperature, then

neutralised with sodium hydrogencarbonate, and concentrated. The residue was eluted from a column of silica gel with chloroform–methanol (5:1), to give **7** (0.62 g, 100%) as tiny prisms, m.p. 122.5–124° (from ethanol).

Anal. Calc. for $C_{14}H_{24}O_5$: C, 62.67; H, 7.51. Found: C, 62.27; H, 7.33.

DL-*(1,3,5/2,4)-3-Acetamido-5-acetoxymethyl-2,4-di-O-acetyl-1-O-benzyl-1,2,4-cyclohexanetriol* (**16**). — Compound **7** (0.70 g, 2.6 mmol) was treated with sodium metaperiodate (1.95 g, 9.1 mmol) in water (10 mL) as described in the preparation of **8**, to give the dialdehyde **15** as a syrup. To a solution of **15** in 1:1 methanol–water (14 mL) was added nitromethane (0.42 mL, 7.8 mmol) and sodium hydrogencarbonate (0.22 g, 2.6 mmol). The mixture was stirred for 70 h at room temperature, then neutralised, and the products were eluted from a column of silica gel with chloroform–methanol (8:1) to give a mixture (0.59 g, 76%) of the nitrotriols. T.l.c. revealed one major and three minor components. A solution of the mixture in methanol (10 mL) containing acetic anhydride was hydrogenated as described in the preparation of **10**, to give a mixture of the *N*-acetyl derivatives, which was fractionated to give a major component (373 mg, 61%) and a mixture (73 mg, 12%) of two minor components. The major compound was acetylated in the usual way to give **16** (453 mg, 40%) as needles, m.p. 164–165° (from ethanol). ^{1}H-N.m.r. data: δ 7.67–7.33 (m, 5 H, Ph), 5.90 (d, 1 H, $J_{3,NH}$ 10.5 Hz, NH), 5.06 and 4.93 (2 t, 2 H, J 10.7 Hz, H-2,4), 4.80 and 4.67 (2 d, 2 H, J 12 Hz, CH_2Ph), 4.26 (q, 1 H, H-3), 4.24 (dd, 1 H, $J_{5,7}$ 5.3, $J_{7,7}$ 12.3 Hz, H-7), 4.03 (dd, 1 H, $J_{5,7'}$ 3.8 Hz, H-7'), 2.06 and 1.90 (2 s, 12 and 3 H, NAc and 4 OAc).

Anal. Calc. for $C_{22}H_{29}NO_8$: C, 60.68; H, 6.71; N, 3.22. Found: C, 60.59; H, 6.67; N, 3.43.

A solution of **16** (38 mg) in ethanol was hydrogenolysed in the presence of 10% Pd/C for 14 h at room temperature. The product was acetylated in the usual way to give **13** (33 mg, 97%) as needles, m.p. 146.5–148° (from ethanol).

DL-*(1,3,4/2,6)-4-Acetamido-6-hydroxymethyl-1,2,3-cyclohexanetriol (N-acetyl-*DL-*validamine)* (**18**). — Penta-*N,O*-acetyl-DL-validamine[11] (**17**; 1.21 g, 3.12 mmol) was treated with methanolic sodium methoxide in the usual way, to give **18** (406 mg, 59%) as prisms, m.p. 207–209° (from ethanol).

Anal. Calc. for $C_9H_{17}NO_5$: C, 49.31; H, 7.82; N, 6.39. Found: C, 49.44; H, 7.69; N, 6.33.

DL-*(1,3,4/2,6)-2,4-Diacetamido-6-acetoxymethyl-1,3-di-O-acetyl-1,3-cyclohexanediol* (**21**). — Compound **18** (150 mg, 0.68 mmol) was oxidised with sodium metaperiodate (0.51 g, 2.4 mmol) in water (5 mL) as described in the preparation of **8**. The dialdehyde obtained was treated with nitromethane (0.11 mL, 2.0 mmol) and sodium hydrogencarbonate (57 mg, 0.68 mmol) in water (5 mL) for 22 h at room temperature. The mixture was processed in the usual way to give a mixture (134 mg, 79%) of the nitrodiols, t.l.c. of which revealed one major and two minor components. A solution of the crude mixture was hydrogenated in methanol containing acetic anhydride, and the products were acetylated. The products were eluted from a column of silica gel with ethanol–toluene (1:4) to give, as the major

component, **21** (125 mg, 47%), isolated as a syrup, and an inseparable mixture (21 mg) of three compounds. Compound **21** was crystallised from ethyl acetate–hexane to give hygroscopic crystals, m.p. 100–110°. ^{1}H-N.m.r. data (270 MHz): δ 6.33 and 5.83 (2 bd, 1 H each, J ~10 Hz, 2 NH), 4.90 (dd, 1 H, $J_{2,3}$ 10.5, $J_{3,4}$ 4.4 Hz, H-3), 4.77 (t, 1 H, $J_{1,2} = J_{1,6}$ = 10.5 Hz, H-1), 4.36 (bq, 1 H, H-2), 4.17 (dd, 1 H, $J_{6,7}$ 4.6, $J_{7,7}$ 11.2 Hz, H-7), 3.89 (dd, 1 H, $J_{6,7'}$ 2.9 Hz, H-7'), 2.05, 2.04, and 2.03 (3 s, 9, 3, and 3 H, 2 NAc and 3 OAc).

Anal. Calc. for $C_{17}H_{26}N_2O_6$: C, 52.84; H, 6.78; N, 7.25. Found: C, 52.27; H, 6.72; N, 6.97.

DL-*(1,3,4/2,6)-4-Acetamido-6-acetamidomethyl-1,2,3-cyclohexanetriol* (**20**). — Compound **19** (766 mg, 1.98 mmol) was *O*-deacetylated with methanolic sodium methoxide to give **20** (516 mg, ~100%), isolated as a syrup. ^{1}H-N.m.r. data (CD_3OD): δ 2.11 and 2.07 (2 s, each 3 H, 2 NAc).

Anal. Calc. for $C_7H_{20}N_2O_5$: C, 50.76; H, 7.75; N, 10.76. Found: C, 50.39; H, 7.55; N, 10.66.

DL-*(1,3,4/2,6)-2,4-Diacetamido-6-acetamidomethyl-1,3-di-O-acetyl-1,3-cyclohexanediol* (**22**). — Compound **20** (330 mg, 1.3 mmol) was oxidised, as described above, with sodium metaperiodate to the dialdehyde, which was treated with nitromethane (0.21 mL, 3.8 mmol) in methanol–water (1:1, 7 mL) and sodium hydrogencarbonate (107 mg, 1.3 mmol) for 50 h at room temperature. The mixture was processed in the usual way and the products were eluted from a column of silica gel with chloroform–methanol (5:1). The major fraction (187 mg) was hydrogenated in methanol containing acetic anhydride, and the product was acetylated and then eluted from a column of silica gel with chloroform–methanol (9:1), to give **22** (170 mg, 35%) as needles, m.p. 160–165° (from aqueous acetone). ^{1}H-N.m.r. data (400 MHz): δ 4.83 (dd, 1 H, $J_{2,3}$ 11, $J_{3,4}$ 3.8 Hz, H-3), 4.71 (t, 1 H, $J_{1,2} = J_{1,6}$ = 11 Hz, H-1), 4.53 (q, 1 H, $J_{4,5a} = J_{4,5e}$ = 3.8 Hz, H-4), 4.26 (t, 1 H, H-2), 3.22 (dd, 1 H, $J_{6,7}$ 3.9, $J_{7,7}$ 13.7 Hz, H-7), 3.15 (dd, 1 H, $J_{6,7'}$ 6.8 Hz, H-7'), 2.03, 2.00, 1.94, 1.92, and 1.87 (5 s, each 3 H, 3 NAc and 2 OAc).

An analytical sample, prepared by drying over P_2O_5 at 110° under vacuum, absorbed one mole of water of crystallisation very rapidly.

Anal. Calc. for $C_{17}H_{27}N_3O \cdot H_2O$: C, 50.61; H, 7.25; N, 10.41. Found: C, 50.41; H, 7.09; N, 10.30.

ACKNOWLEDGMENTS

We thank Mr. Hisao Arita for elemental analyses, and Dr. Noritaka Chida for measurements of the 400-MHz ^{1}H-n.m.r. spectra. This work was partially supported by a grant of the Asahi Glass Foundation for the contribution to industrial technology.

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