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FACILE SYNTHESIS OF 2-METHYL-[4,6-DI-*O*-ACETYL-1,2-DIDEOXY-3-*O*-(2,3,4,6-TETRA-*O*-ACETYL-D-GLYCOPYRANOSYL)-α-D-GLUCOPYRANO]-[2′,1′:4,5]-2-OXAZOLINES, KEY INTERMEDIATES FOR THE SYNTHESIS OF OLIGOSACCHARIDES*

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ABSTRACT

A simple synthesis of disaccharide oxazolines has been developed. Condensation of methyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-α-D-glucopyranoside with 2,3,4,6-tetra-*O*-acetyl-α-D-galactopyranosyl bromide, followed by removal of the 4′,6′-*O*-benzylidene group from the resulting disaccharide derivative, gave crystalline methyl 2-acetamido-2-deoxy-3-*O*-(2,3,4,6-tetra-*O*-acetyl-β-D-galactopyranosyl)-α-D-glucopyranoside which, on acetolysis with acetic anhydride–acetic acid–sulfuric acid, provided 2-methyl-[4,6-di-*O*-acetyl-1,2-dideoxy-3-*O*-(2,3,4,6-tetra-*O*-acetyl-β-D-galactopyranosyl)-α-D-glucopyrano]-[2′,1′:4,5]-2-oxazoline (**7**). Synthesis of the related α-D-mannopyranosyl compound was similarly accomplished. The glycosylating capability of **7** was employed for the synthesis of 6-(benzyloxycarbonylamino)hexyl 2-acetamido-4,6-di-*O*-acetyl-2-deoxy-3-*O*-(2,3,4,6-tetra-*O*-acetyl-β-D-galactopyranosyl)-β-D-glucopyranoside (**18**). An alternative synthesis of compound **18** is also described.

INTRODUCTION

Our continued interest in the preparation of 2-methylglyco[2′,1′:4,5]-2-oxazolines[1–3] as suitable glycosylating agents for the synthesis of 1,2-*trans*-2-acetamido-2-deoxy-D-glucopyranosides has led to a new method for the synthesis of disaccharide oxazolines. The synthesis of certain such oxazolines from disaccharides containing 2-acetamido-2-deoxy-D-glucopyranose as the reducing residue has been achieved from acylated glycosyl halides[4–6] derived from the parent disaccharide. For preparation of the oxazoline, the halide in acetone may be treated with collidine in the presence of silver nitrate. Alternatively, the glycosyl halide in acetonitrile containing tetraethylammonium chloride is exposed to sodium hydrogencarbonate.

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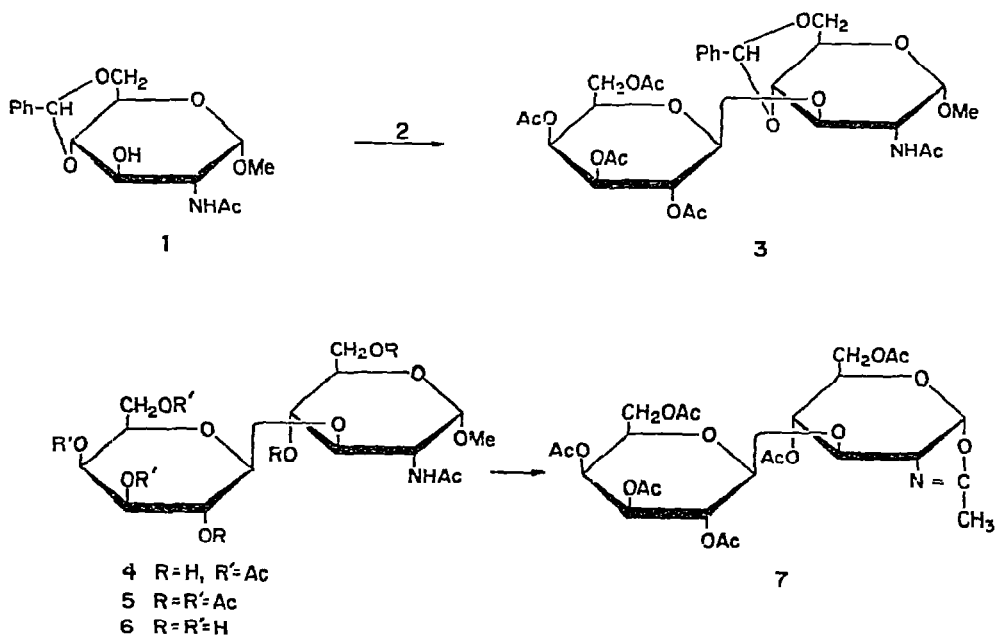
Anhydrous ferric chloride in dichloromethane has been successfully used for the preparation of various monosaccharide oxazolines from acetylated 2-acetamido-2-deoxyglycopyranose derivatives having suitable anomeric configuration[1–3], and for the facile preparation of disaccharide oxazolines[6,7].

Jeanloz and coworkers[8] reported that treatment of methyl 2-acetamido-4,6-di-*O*-acetyl-2-deoxy-3-*O*-[D-1-(methoxycarbonyl)ethyl]-α-D-glucopyranoside with an acetolysis mixture produces the corresponding oxazoline in 67% yield. We have now extended the use of these reaction conditions to the facile preparation of the title oxazolines.

RESULTS AND DISCUSSION

Glycosidation of 2-acetamido-2-deoxy-D-glucose with methanol containing 2% of hydrogen chloride was conducted for a considerable time; the crude mixture thus obtained was re-*N*-acylated, and the product treated with benzaldehyde in the presence of anhydrous zinc chloride. Fractional recrystallization of the product provided[9] pure methyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-α-D-glucopyranoside (**1**). Condensation of **1** with 2,3,4,6-tetra-*O*-acetyl-α-D-galactopyranosyl bromide (**2**) in 1:1 benzene–nitromethane in the presence of mercuric cyanide afforded crystalline **3** in 49% yield. Removal of the 4,6-*O*-benzylidene group from **3** with dilute acetic acid gave the crystalline diol (**4**) in 62% yield. On treatment with acetic anhydride and pyridine, compound **4** gave the acetate **5**.



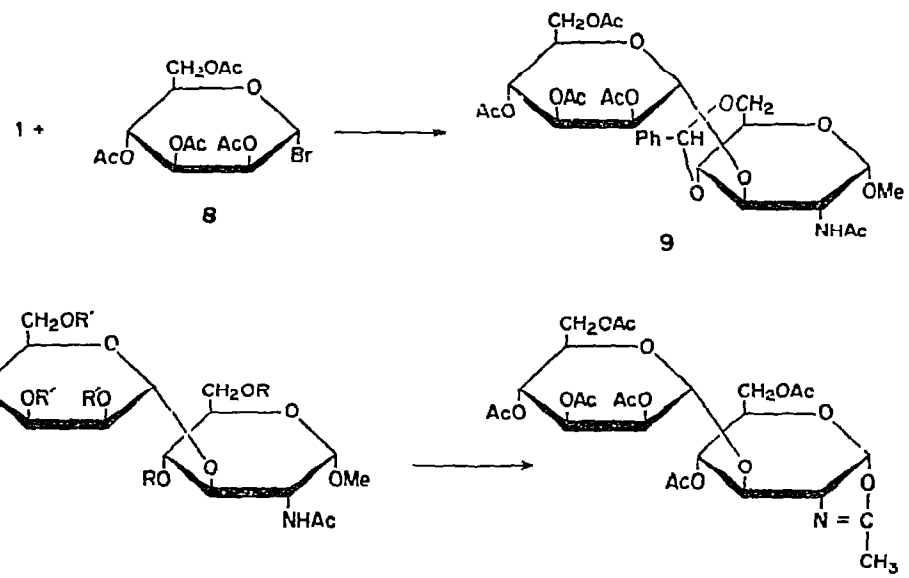
1 3

4 R=H, R'=Ac
5 R=R'=Ac
6 R=R'=H

7

For the preparation of oxazoline **7**, compound **4** was treated[8] with a mixture of acetic anhydride, acetic acid, and sulfuric acid. T.l.c. of syrupy **7** revealed the presence of some minor impurities. However, the structure assigned the compound was clearly supported by its infrared and n.m.r. spectra. The slightly impure oxazoline, without purification, was found suitable for *O*-glycosylation.

The use of 2,3,4,6-tetra-*O*-benzoyl-α-D-mannopyranosyl bromide has been preferred for the synthesis of α-D-mannopyranosyl derivatives[10,11]. Interestingly, sugar derivatives having an α-D-mannopyranosyl linkage can also be conveniently prepared from 2,3,4,6-tetra-*O*-acetyl-α-D-mannopyranosyl bromide (**8**) by treating it with an aglycon hydroxide in the presence of mercuric cyanide in nitromethane–benzene[12]. Consequently, the readily accessible bromide **8** was condensed with **1** under the conditions favoring formation of the α-D-mannopyranosyl linkage, to give **9**. The 4,6-*O*-benzylidene group was cleaved from **9** by treatment with dilute acetic acid, affording crystalline **10**. Treatment of **10** with the acetolysis mixture, followed by the usual processing, gave the desired oxazoline (**13**) as a syrup that could not be crystallized. The contaminants in **13** were quite minor in comparison to those present in **7**. It may be mentioned that, by the method using anhydrous ferric chloride, we have obtained crystalline 2-methyl-[3,4-di-*O*-acetyl-6-*O*-(2,3,4,6-tetra-*O*-acetyl-α-D-mannopyranosyl)-α-D-glucopyrano]-[2′,1′:4,5]-2-oxazoline from 2-acetamido-1,3,4-tri-*O*-acetyl-2-deoxy-(2,3,4,6-tetra-*O*-acetyl-α-D-mannopyranosyl)-β-D-glucopyranose.

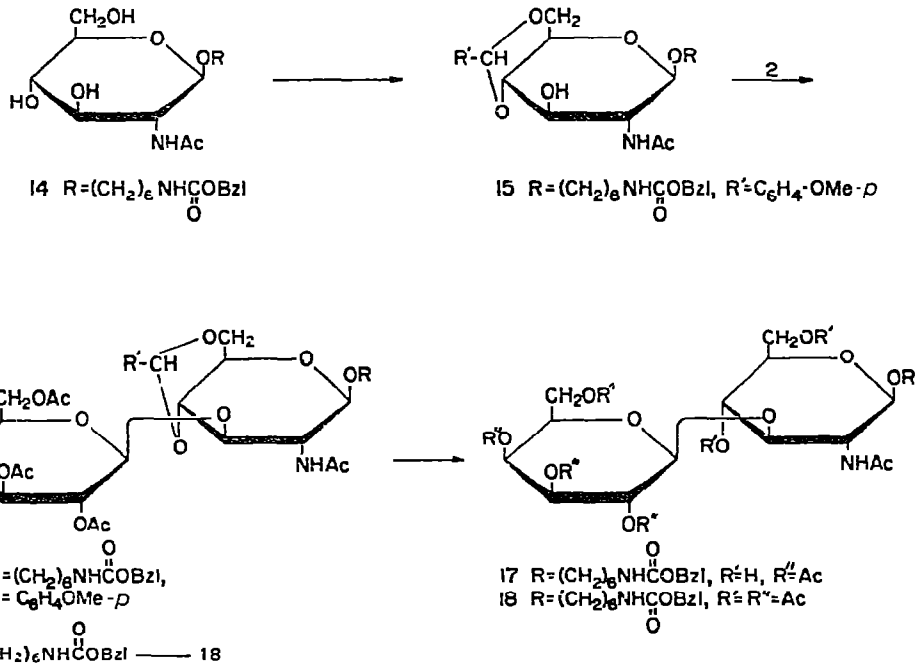


10 R=H, R′=Ac
11 R=R′=Ac
12 R=R′=H

13

*K. L. Matta, unpublished results.

Treatment of 6-(benzyloxycarbonylamino)hexyl 2-acetamido-2-deoxy-β-D-glucopyranoside[1] (**14**) with *p*-methoxybenzaldehyde in the presence of anhydrous zinc chloride gave **15** in 66% yield. Condensation of **15** with bromide **2** under the usual conditions, followed by the sequence of reactions described for the preparation of **4**, gave the crystalline diol **17** which, on treatment with acetic anhydride and pyridine, afforded **18**. In another approach, a solution of oxazoline **7** and 6-(benzyloxycarbonylamino)-1-hexanol[14] in the presence of *p*-toluenesulfonic acid as the catalyst gave a product which, after column chromatography on silica gel, was found to be identical with **18** on the basis of t.l.c. and infrared studies.



During these synthetic investigations, Augé and Veyrières[6] reported an elegant synthesis of oxazoline **7** from the acetylated product obtained from benzyl 2-acetamido-4,6-*O*-benzylidene-2-deoxy-β-D-glucopyranoside and bromide **2**, followed by removal of the benzylidene group and *O*-acetylation. According to our studies, the readily acessible **1** can be quite conveniently employed for the preparation of these oxazolines. However, the purity of the oxazoline resulting from methyl 2-acetamido-2-deoxy-α-D-glucopyranoside derivatives may be dependent upon the nature of the protecting groups present in this molecule, as, in our preliminary studies, acetolysis of methyl 2-acetamido-3-*O*-benzyl-2-deoxy-α-D-glucopyranoside gave the corresponding oxazoline accompanied by other products which seemed to preponderate.

EXPERIMENTAL

General. — Melting points were determined with a Fisher–Johns apparatus and are uncorrected. I.r. spectra were recorded with a Perkin–Elmer Model 457 spectrophotometer. N.m.r. spectra were recorded with a Varian XL-100 spectrometer. Optical rotations were measured with a Perkin–Elmer Model 141 Polarimeter. The purity of the compounds was examined by ascending, thin-layer chromatography (t.l.c.) conducted on plates coated with a 250-μm layer of silica gel HF254 (Merck, Darmstadt), and the spray reagent was potassium permanganate–sulfuric acid. The solvents for t.l.c. were (*a*) 9:1 benzene–methanol, (*b*) 4:1 benzene–methanol, (*c*) 3:2 benzene–methanol (*d*) 9:1 chloroform–ethanol, (*e*) 14:14:1 benzene–ether–methanol, and (*f*) 10:10:1 chloroform–ether–methanol. The elementary analyses were performed by Robertson Laboratory, Florham Park, New Jersey.

Methyl 2-acetamido-4,6-O-benzylidene-2-deoxy-3-O-(2,3,4,6-tetra-O-acetyl-β-D-galactopyranosyl)-α-D-glucopyranoside (**3**). — A solution of **1** (9.70 g, 30 mmoles) in 1:1 benzene–nitromethane (900 ml) was boiled under reflux until 100 ml of the solvent mixture had distilled off; while the temperature was maintained at 58–60°, mercuric cyanide (7.56 g, 30 mmoles), a solution of 2,3,4,6-tetra-α-D-galactopyranosyl bromide (**6**) (12.36 g, 30 mmoles) in 1:1 benzene–nitromethane (50 ml) and calcium sulfate (Drierite, 40 g) were added, and the mixture was stirred for 24 h. The same amounts of mercuric cyanide and bromide **2** were then introduced, and the mixture was stirred for 40 h at 58–60°. The solids were removed by filtration through a Celite pad, and washed with benzene (500 ml). The filtrates were combined, successively washed twice with aqueous potassium iodide solution, twice with saturated aqueous sodium hydrogencarbonate solution, and water until neutral, dried[15] (sodium sulfate), and evaporated to a syrup which was dissolved in warm benzene (~200 ml) and cooled to room temperature. The solution was diluted with pentane (400 ml) with stirring, affording a thick syrup. The solvents were decanted, and the syrup was redissolved in benzene (150 ml), and diluted with ether (150 ml) and then with pentane, with stirring. A gelatinous, crystalline material appeared, and the suspension was kept for 48 h at room temperature. The solid material was collected by filtration, and washed with benzene–ether–pentane. T.l.c. of this material (~15 g) indicated minor, slow-moving impurities. Pure **3** was obtained by recrystallization from ethanol–hexane; yield 9.7 g (49.5%); m.p. 138–140° (softens at 120–122°), $[\alpha]_D^{23}$ +16° (*c* 3, chloroform); ν_{max}^{KBr} 3310 (NH), 1750 (OAc), 1660 (Amide I), 1530 (Amide II), 1220 (OAc), and 700 cm^{-1} (Ph).

Anal. Calc. for $C_{30}H_{39}NO_{15}$: C, 55.12; H, 6.01; N, 2.14. Found: C, 54.96; H, 6.24; N, 1.99.

Methyl 2-acetamido-2-deoxy-3-O-(2,3,4,6-tetra-O-acetyl-β-D-galactopyranosyl)-α-D-glucopyranoside (**4**). — A solution of **3** (5.8 g) in acetic acid (60%; 400 ml) was stirred for 40 min at 100°. The solvent was evaporated *in vacuo*, and traces of acetic acid were removed by co-distillation with water. The resulting syrup was dissolved in chloroform (300 ml), and the solution was washed with water (2 × 100 ml), dried

(sodium sulfate), and evaporated to dryness. The residue crystallized from chloroform–ether–pentane, to give pure **4**, yield 3.2 g (61.8%); m.p. 129–132° (softens at 95–98°), $[\alpha]_D^{23}$ +46.2° (*c* 2, chloroform): ν_{max}^{KBr} 3500–3300 (broad, OH and NH), 1740 (OAc), 1660 (Amide I), 1530 (Amide II), and 1230 cm^{-1} (OAc); n.m.r. data ($CDCl_3$): τ 4.08 (1 H, d, *J* 9 Hz, NH), 4.62 (1 H, d, *J* 3.5 Hz, H-1), 6.6 (3 H, OCH_3), and 7.8–8.08 (15 H, 4 OAc and NAc).

Anal. Calc. for $C_{23}H_{35}NO_{15} \cdot H_2O$: C, 47.33; H, 6.39; N, 2.40. Found: C, 47.48; H, 6.23; N, 2.29.

Methyl 2-acetamido-4,6-di-O-acetyl-2-deoxy-3-O-(2,3,4,6-tetra-O-acetyl-β-D-galactopyranosyl)-α-D-glucopyranoside (**5**). — A solution of **4** (0.2 g) in anhydrous pyridine (6 ml) was treated with acetic anhydride (4 ml) for 36 h at room temperature. Evaporation, and co-distillation with toluene, produced a residue which crystallized from benzene–hexane to give **5**, yield 0.19 g (85.3%); m.p. 172–175° (softens at 110–115°), $[\alpha]_D^{23}$ +28° (*c* 1, chloroform): ν_{max}^{KBr} 3330 (NH), 1750 (OAc), 1660 (Amide I), 1530 (Amide II), and 1230 cm^{-1} (OAc): n.m.r. data ($CDCl_3$): τ 4.42 (1 H, d, *J* 9 Hz, NH), 6.62 (3 H, OCH_3), and 7.8–8.08 (21 H, 6 OAc and NAc).

Anal. Calc. for $C_{27}H_{39}NO_{17}$: C, 49.92; H, 6.05; N, 2.15. Found: C, 49.71; H, 6.06, N, 1.83.

Methyl 2-acetamido-2-deoxy-3-O-β-D-galactopyranosyl-α-D-glucopyranoside (**6**). — A solution of compound **4** (0.2 g) in methanol (3 ml) was treated with triethylamine (0.7 ml) and water (0.5 ml) for 24 h at 4°, and evaporated to dryness. The residue was co-evaporated with toluene, and the resulting, white residue crystallized from methanol–ether, to give chromatographically pure **6** (yield 0.14 g, 98.3%); m.p. 236–239°, $[\alpha]_D^{23}$ +57.0° (*c* 1, water): ν_{max}^{KBr} 3400 (OH), 3340 (NH), 1620 (Amide I), and 1530 cm^{-1} (Amide II): n.m.r. data (Me_2SO-d_6–D_2O): τ 5.38 (1 H, d, *J* 3.5 Hz, H-1), 6.72 (3 H, OCH_3), and 8.18 (3 H, NAc).

Anal. Calc. for $C_{15}H_{27}NO_{11} \cdot H_2O$: C, 43.37; N, 7.03; N, 3.37. Found: C, 43.15; H, 7.16; N, 3.16.

2-Methyl-[4,6-di-O-acetyl-1,2-dideoxy-3-O-(2,3,4,6-tetra-O-acetyl-β-D-galactopyranosyl)-α-D-glucopyrano[2',1':4,5]-2-oxazoline (**7**). — A solution of compound **4** (0.8 g) in a mixture of acetic anhydride (8.6 ml), acetic acid (5.6 ml), and sulfuric acid (0.1 ml) was kept for 48 h at room temperature. It was then diluted with ice-cold dichloromethane (50 ml), washed with ice-cold saturated sodium hydrogencarbonate solution and three times with ice-cold water, dried (sodium sulfate), and evaporated; traces of acetic anhydride and acetic acid were removed by co-evaporation with toluene, to give a syrup (0.7 g, 82.7%), t.l.c. (in solvent *e*, or *f*) of which showed two minor impurities: $[\alpha]_D^{23}$ +9.0° (*c* 3, chloroform) (lit.[7] $[\alpha]_D$ +5°); ν_{max}^{neat} 1745 (OAc), 1670 (C=N), and 1225 cm^{-1} (OAc), lit.[7] ν_{max} 1740 (OAc), 1667 (C=N), and 1225 cm^{-1} (OAc); n.m.r. data ($CDCl_3$): τ 4.04 (1 H, d, *J* 6.5 Hz, H-1) and 7.9–8.08 (21 H, 6 OAc and C–CH_3).

Methyl 2-acetamido-4,6-O-benzylidene-2-deoxy-3-O-(2,3,4,6-tetra-O-acetyl-α-D-mannopyranosyl)-α-D-glucopyranoside (**9**). — A solution of **1** (2.0 g, 5.2 mmoles) in 1:1 benzene–nitromethane (200 ml) was boiled until ~40 ml of the solvent mixture

had distilled off, and then cooled to 50–55°. Mercuric cyanide (1.57 g, ~6.2 mmoles) and a solution of 2,3,4,6-tetra-*O*-acetyl-α-D-mannopyranosyl bromide (**8**, 2.5 g, ~6.2 mmoles) in 20 ml of 1:1 benzene–nitromethane were added, and the mixture was stirred for 24 h at 50–55°. Additional amounts of **8** (1.7 g, ~4 mmoles) and mercuric cyanide (1 g, ~4 mmoles) were then added, and stirring was continued for another 40 h. The mixture was cooled, diluted with benzene (~200 ml), washed with saturated sodium hydrogencarbonate solution followed by water until neutral, dried (sodium sulfate), and evaporated under diminished pressure to a syrup which was dissolved in benzene (100 ml). The solution was diluted with pentane (~400 ml) with stirring, and a semi-solid material appeared; the solvents were decanted, and the residue was washed with pentane (~50 ml), and dried. The residue (~4 g) was dissolved in benzene (25 ml), and the solution was diluted with ether (~100 ml) and pentane, with stirring. The resulting crystals were filtered off, and washed with ether–pentane, to give pure **9**, yield 2.7 g (67.9%); m.p. 203–205°, $[\alpha]_D^{23}$ +44° (*c* 1, chloroform); ν_{max}^{KBr} 3280 (NH), 1750 (OAc), 1650 (Amide I), 1550 (Amide II), 1240 (OAc), and 700 cm^{-1} (Ph).

Anal. Calc. for $C_{30}H_{38}NO_{15}$: C, 55.12; H, 6.01; N, 2.14. Found: C, 55.11; H, 5.21; N, 2.04.

Methyl 2-acetamido-2-deoxy-3-O-(2,3,4,6-tetra-O-acetyl-α-D-mannopyranosyl)-α-D-glucopyranoside (**10**). — A solution of **9** (2.5 g) in glacial acetic acid (120 ml) at 100° was diluted with water (60 ml). The mixture was stirred for 40 min at 100°, cooled, and evaporated *in vacuo*, and traces of acetic acid were removed by repeated co-distillation with water. The residue was extracted with chloroform, and the extract was washed with water, dried (sodium sulfate), and evaporated to a syrup which crystallized from chloroform–ether–hexane, affording pure **9** (1.25 g, 53.8%), m.p. 102–104°, $[\alpha]_D^{23}$ +77.1° (*c* 0.76, chloroform); ν_{max}^{KBr} 3480–3320 (broad OH and NH), 1740 (OAc), 1655 (Amide I), 1530 (Amide II), and 1225 cm^{-1} (OAc); n.m.r. data ($CDCl_3$): τ 4.0 (1 H, d, *J*, 9 Hz, NH), 6.6 (3 H, OCH_3), and 7.85–8.04 (15 H, 4 OAc and 1 NAc).

Anal. Calc. for $C_{23}H_{35}NO_{15}\cdot H_2O$: C, 47.33; H, 6.39; N, 2.40. Found: C, 47.20; H, 6.09; N, 2.39.

Methyl 2-acetamido-4,6-di-O-acetyl-2-deoxy-3-O-(2,3,4,6-tetra-O-acetyl-α-D-mannopyranosyl)-α-D-glucopyranoside (**11**) — A solution of **10** (0.2 g) in pyridine (6 ml) was treated with acetic anhydride (4 ml) for 36 h at room temperature. The mixture was processed as described for the preparation of **5**, to give a syrup that crystallized from benzene–ether–hexane; recrystallized from chloroform–ether–hexane, it gave analytically pure **11** (0.18 g, 80.8%), m.p. 184–186°, $[\alpha]_D^{23}$ +61.6° (*c* 0.64, chloroform); ν_{max}^{KBr} 3225 (NH), 1750 (OAc), 1645 (Amide I), 1540 (Amide II), and 1230 cm^{-1} (OAc); n.m.r. data ($CDCl_3$): τ 4.25 (1 H, d, *J* 9 Hz, NH), 6.62 (3 H, OCH_3), and 7.88–8.04 (21 H, 6 OAc and NAc).

Anal. Calc. for $C_{27}H_{39}NO_{17}$: C, 49.92; H, 6.05; N, 2.15. Found: C, 49.93; H, 6.10; N, 1.94.

Methyl 2-acetamido-2-deoxy-3-O-α-D-mannopyranosyl-α-D-glucopyranoside (**12**). — A suspension of **10** (0.2 g) in methanol (3 ml) was stirred with triethylamine (0.7 ml) and water (0.5 ml). The clear solution thus obtained (after 15–20 min) was kept overnight in a cold-room. Compound **12** was isolated as described for the preparation of **6**, and crystallized from methanol–ether, yield 0.13 g (93.3%), m.p. 275–276° (dec.), $[\alpha]_D^{23}$ +100.7° (*c* 1, water); ν_{max}^{KBr} 3500–3240 (broad, OH and NH), 1630 (Amide I), and 1570 cm^{-1} (Amide II); n.m.r. data (Me_2SO-d_6–D_2O): τ 5.44 (1 H, d, *J* 3.5 Hz, H-1), 6.84 (3 H, OCH_3), and 8.14 (3 H, NAc).

Anal. Calc. for $C_{15}H_{27}NO_{11}\cdot 0.5H_2O$: C, 44.33; H, 6.94; N, 3.44. Found: C, 44.39; H, 7.39; N, 3.01.

2-Methyl-[4,6-di-O-acetyl-1,2-dideoxy-3-O-(2,3,4,6-tetra-O-acetyl-α-D-mannopyranosyl)-α-D-glucopyrano]-[2',1':4,5]-2-oxazoline (**13**). — Treatment of **10** (0.4 g) with a mixture of acetic anhydride (3.4 ml), acetic acid (2.8 ml), and conc. sulfuric acid (0.05 ml) for 48 h at room temperature, followed by processing as described for the preparation of **7**, produced **13** as a colorless syrup, yield 0.35 g (82.7%), t.l.c. (solvent *e*, or *f*) of which showed minor impurities; $[\alpha]_D^{23}$ +39.5° (*c* 1, chloroform); ν_{max}^{neat} 1750 (OAc), 1670 (C=N), and 1225 cm^{-1} (OAc); n.m.r. data ($CDCl_3$): τ 3.98 (1 H, d, *J* 6.0 Hz, H-1) and 7.8–8.0 (21 H, 6 OAc and C-CH_3) (OCH_3 and NH groups absent).

6-(Benzyloxycarbonylamino)hexyl 2-acetamido-2-deoxy-4,6-O-(p-methoxybenzylidene)-β-D-glucopyranoside (**15**). — A mixture of 6-(benzyloxycarbonylamino)-hexyl 2-acetamido-2-deoxy-β-D-glucopyranoside (**14**) (4.0 g), anhydrous zinc chloride (4 g), and *p*-methoxybenzaldehyde (40 ml) was shaken for 3 days at room temperature, and then stirred with ether and cold water, and filtered. The solid was washed with an excess of cold water, air-dried, and recrystallized from *N*,*N*-dimethylformamide–water, to give pure **14**, yield 3.2 g (66%), m.p. 210–212°, $[\alpha]_D^{23}$ −50.3° (*c* 1, *N*,*N*-dimethylformamide); ν_{max}^{KBr} 3460 (OH), 3340 (NH), 1690 (C=O of $NHCOCH_2Ph$), 1630 (Amide I), 1550, 1520 (Amide II), and 700 cm^{-1} (Ph).

Anal. Calc. for $C_{30}H_{40}N_2O_9$: C, 62.91; H, 7.04; N, 4.89. Found: C, 62.82; H, 7.25; N, 4.77.

6-(Benzyloxycarbonylamino)hexyl 2-acetamido-2-deoxy-3-O-(2,3,4,6-tetra-O-acetyl-β-D-galactopyranosyl)-β-D-glucopyranoside (**17**). — A solution of compound **15** (1.71 g, ~3 mmoles) in 1:1 benzene–nitromethane (200 ml) was boiled until ~40 ml of the solvent mixture had distilled off. The mixture was stirred at 58–60° while mercuric cyanide (0.76 g, ~3 mmoles) and bromide **2** (1.25 g, ~3 mmoles) in 1:1 benzene–nitromethane (10 ml) were added. After 24 h, the same amounts of bromide **2** and mercuric cyanide were introduced, and the reaction was allowed to proceed for another 36 h at 58–60°. The mixture was then processed as described for the preparation of **3**. The residue obtained from benzene–ether–pentane crystallized from chloroform–pentane, to give **16**, yield 2.0 g, m.p. 123–127°, $[\alpha]_D^{23}$ −1.8° (*c* 1, chloroform); ν_{max}^{KBr} 3300 (NH), 1750 (OAc), 1660 (Amide I), 1550 (Amide II), 1230 (OAc), and 700 cm^{-1} (Ph). The compound was used for the next step without purification.

A solution of compound **16** (1 g) in dilute acetic acid (60%, 100 ml) was stirred for 40 min at 100° and evaporated, and the mixture was processed as described for the isolation of **4**, to give **17** as crystalline material (from chloroform–ether), yield 0.5 g (41.7%, based on **14**), m.p. 124–126°, $[\alpha]_D^{23}$ +11.1° (*c* 0.85, chloroform); ν_{max}^{KBr} 3480 (OH), 3300 (NH), 1750 (OAc), 1655 (Amide I), 1550–1530 (Amide II), 1225 (OAc), and 700 cm^{-1} (Ph).

Anal Calc. for $C_{36}H_{52}N_2O_{17}\cdot H_2O$: C, 53.84; H, 6.78; N, 3.49. Found: C, 53.78; H, 6.66; N, 3.28.

6-(Benzyloxycarbonylamino)hexyl 2-acetamido-4,6-di-O-acetyl-2-deoxy-3-O-(2,3,4,6-tetra-O-acetyl-β-D-galactopyranosyl)-β-D-glucopyranoside (**18**). — A solution of **17** (0.2 g) in a mixture of pyridine (4 ml) and acetic anhydride (2 ml) was kept for 24 h at room temperature, and then evaporated under diminished pressure; traces of acetic anhydride and pyridine were removed by co-distillation with toluene. A solution of the residue in chloroform (~20 ml) was washed with water, dried (sodium sulfate), treated with carbon black, and filtered through a Celite pad. Evaporation of the filtrate gave a syrup which, on co-evaporation with toluene, followed by evaporation with ether, and drying under vacuum, afforded **18** as a hygroscopic solid, $[\alpha]_D^{23}$ +0.8° (*c* 1, chloroform); ν_{max}^{KBr} 3400 (NH), 1750 (OAc), 1660 (Amide I), 1550–1530 (Amide II), 1230 (OAc), and 700 cm^{-1} (Ph).

Synthesis of **18** *from* **7**. — A solution of oxazoline **7** (0.4 g) and 6-(benzyloxycarbonylamino)-1-hexanol[14] (0.3 g) in 1:1 nitromethane–toluene (18 ml) was heated at 120–130° in the presence of a catalytic amount of *p*-toluenesulfonic acid (7 mg). When 5 ml of the solvent mixture had distilled off (after ~1 h), an additional amount of catalyst (5 mg) was added, and the reaction was continued at the same temperature for another 30 min. The mixture was then cooled, and the acid was neutralized with a few drops of pyridine. The solution was evaporated to a syrup which was stirred with water, and extracted with chloroform (~30 ml). The extract was washed with water, dried, and filtered. The filtrate was treated with carbon black, the suspension filtered, and the filtrate evaporated to a syrup (~0.6 g), t.l.c. (solvent *e* or *f*) of which showed the presence of **18** as the major component. The syrup was dissolved in chloroform, and the solution applied to a column (2 × 25 cm) of silica gel. Elution was performed with chloroform (~250 ml), followed by 10:10:1 chloroform–ether–methanol to elute the desired material (**18**). The fractions containing **18** were combined, and evaporated to a syrup which, on co-evaporation with toluene followed by co-evaporation with ether and drying under vacuum, afforded compound **18** (0.35 g, 62%), $[\alpha]_D^{23}$ −1.5° (*c* 1, chloroform); identical with **18** on the basis of t.l.c. and infrared studies.

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