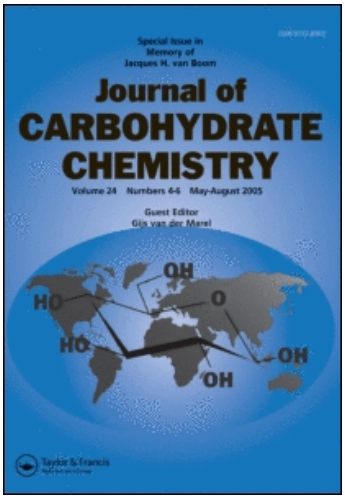

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ACETYL MIGRATION IN PARTIALLY ACETYLATED D-GLUCOPYRANOSIDES AND ACYLAMIDOHEXOPYRANOSIDES

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ABSTRACT

O-4→O-6 Acetyl migrations in partially O-acetylated 2- and 3-acylamidodeoxyhexopyranosides, including derivatives of kanamycin A, were found to be particularly suited to allow the regiospecific accessibility of their respective C-4 OH groups. Partially O-acetylated D-glucopyranosides, compared to the substrates above, showed slightly different aptitudes of migration. However, all O-4→O-6 migrations investigated proved to be irreversible under the conditions applied.

INTRODUCTION

A topic of our current interest is chemical modification at C-4 in aminodeoxyhexopyranosides, including aminoglycoside antibiotics. One of the prerequisites for such transformations is regiospecific accessibility of the C-4 hydroxyl group. Generally, the preparative approaches used for this purpose employ the selective protection of the hydroxyl function at C-6 in appropriately 2,3-disubstituted hexopyranosides. This method takes advantage of the marked difference between the reactivities of the hydroxyl groups at C-6 and C-4.

In addition to this strategy, O-4→O-6 acetyl migration in partially O-acetylated hexopyranosides appears to be of considerable potential for the regiospecific deprotection of C-4 hydroxyl groups. Although such intramole-

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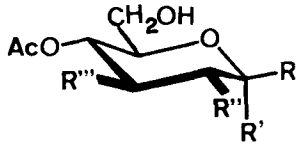
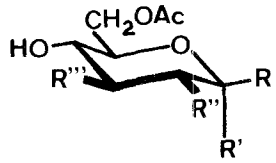


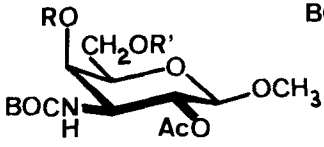


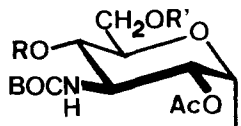
1 /R = OCH_2Ph; R' = H; R" = NHBz; R"' = OAc/ 2

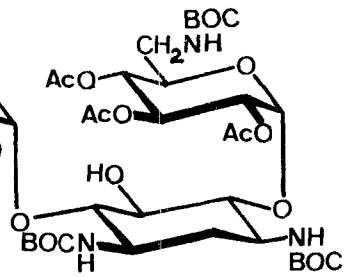
3 /R = OCH_3; R' = H; R" = OAc; R"' = NHBOC/ 4

9 / R = H; R' = OCH_3; R" = R"' = OAc/ 10

11 /R = OCH_3; R' = H; R" = R"' = OCH_2Ph/ 12





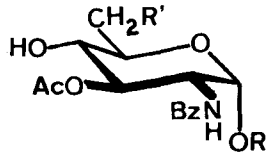


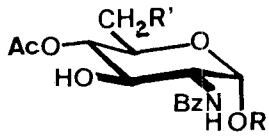
5 R = Ac; R' = H

6 R = H; R' = Ac

7 R = Ac; R' = H

8 R = H; R' = Ac





13 /R = CH_2Ph; R' = I/ 14

15 / R = CH_3; R' = Br/ 16

cular, acid or base catalyzed transesterifications have been investigated, [2-9] the reported yields of pure products are low.

In 1971 we described [10] the O-4⟶O-6 acetyl migration (in aqueous pyridine) in benzyl 3,4-di-O-acetyl-2-benzamido-2-deoxy-ß-D-glucopyranoside (1) leading to exclusive formation of the 3,6-di-O-acetyl derivative 2. In view of this single and hitherto neglected result, investigation of O-4⟶O-6 acetyl migrations in other aminodeoxyhexopyranosides appeared to be indicated.

RESULTS AND DISCUSSION

Methyl 2,4-di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-glucopyranoside (3) and methyl 2,4-di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-galactopyranoside (5) as well as 2',3',4',2",4"-penta-O-acetyl-tetra-N-t-butoxycarbonylkanamycin A (7) were obtained from the corresponding N-t-butoxycarbonyl aminodeoxy sugars by tritylation, acetylation, and detritylation. In a manner analogous to the behavior of 1, compounds 3, 5, and 7 in aqueous pyridine (method A) were subject to O-4⟶O-6 acetyl migration to produce their respective 6-acetates (4, 6, and 8) in yields of 95% each. Products 2, 4, 6, and 8 remained unchanged during chromatography on silica gel and showed no indication of reverse O-6⟶O-4 migration in aqueous pyridine.

When each of the compounds 1, 3, 5, and 7 was reacted with aqueous, alcoholic sodium hydroxide (method B), another medium used to promote acyl migrations, the reaction rates increased dramatically. Lower yields were observed, however, presumably due to partial saponification of the 6-O-acetyl group. This reaction lowered hydroxide ion concentration to a level insufficient for complete migration. In addition to this side effect, which could be diminished by adding the alkali in several portions, compound 2 also experienced acetyl migration originating at O-3, which accounts for the still lower yield of 2 when compared to those of 4, 6, and 8.

TABLE 1. Results of O-4⟶O-6 Acetyl Migrations.

Reactants X=4		Method	Time	Yield	Products X=6
Benzyl 3,X-di-O-acetyl-2-benzamido-2-deoxy-ß-D-glucopyranoside	1	A	2h	93	2
		B	1/6h	77	
Methyl 2,X-di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-glucopyranoside	3	A	48h	95	4
		B	1/6h	83	
Methyl 2,X-di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-galactopyranoside	5	A	48h	95	6
		B	1/6h	84	
2',3',4',2",X"-Penta-O-acetyl-tetra-N-t-butoxycarbonylkanamycin A	7	A	48h	95	8
		B	1/6h	88	
Methyl 2,3,X-tri-O-acetyl-α-D-glucopyranoside	9	A	48h	73	10
		B	1/6h	76	
Methyl X-O-acetyl-2,3-di-O-benzyl-ß-D-glucopyranoside	11	A	72h	88	12
		B	1/6h	74	

The favorable results described above with O-4⟶O-6 acetyl migrations in aminodeoxyhexopyranosides, already successfully applied in chemical modifications of kanamycin A, [11] called for a comparative study of the migratory aptitudes of partially O-acetylated hexopyranosides. For this purpose methyl 2,3,4-tri-O-acetyl-α-D-glucopyranoside (9) and methyl 4-O-acetyl-2,3-di-O-benzyl-ß-D-glucopyranoside (11), one bearing a potentially migrating and the other a nonmigrating group at O-3, were selected. Except for methyl 6-O-acetyl-2,3-di-O-benzyl-ß-D-glucopyranoside (12), which crystallized from aqueous pyridine thereby shifting the equilibrium, the yields of the respective O-4⟶O-6 acetyl migrations were lower than those observed for compounds 1, 3, 5, and 7. Compounds 10 and 12 showed no sign of O-6⟶O-4 acetyl migration. The position of the acetyl groups in compound 10 was proved by 4-bromobenzene sulphonylation, nucleophilic substitution with acetate and de-O-acetylation, which led to methyl α-D-galactopyranoside.

In as much as there are no reports on O-3⟶O-4 acetyl migrations, a probable side reaction for compounds 2 and 10, the migratory aptitudes of benzyl 3-O-acetyl—2-benz-

amido-2,6-dideoxy-6-iodo-α-D-glucopyranoside (13) and methyl 3-O-acetyl-2-benzamido-6-bromo-2,6-dideoxy-α-D-glucopyranoside (15) were investigated. Both compounds, in aqueous pyridine, exhibited slow O-3→O-4 acetyl migration, yielding, after 60 h, mixtures of the respective C-3 and C-4 acetates in a ratio of 3:1. The C-4 acetates 14 and 16, isolated by chromatography, were again subjected to the reaction conditions and experienced the hitherto unknown O-4→O-3 acetyl migration with formation of the same ratios of isomers mentioned above.

The results compiled in the Table lead to the following conclusions.

1. O-4→O-6 Acetyl migration is a very useful and generally applicable method for the regiospecific deprotection of hydroxyl groups at C-4 in hexopyranosides.
2. Although O-acetyl migrations in general lead to equilibrium mixtures, O-4→O-6 rearrangements of acetyl groups appear to be irreversible.
3. Generally, the yields in O-4→O-6 acetyl migration products from 2- or 3-aminodeoxyhexopyranosides are higher than those of migration products from other hexopyranosides.
4. Despite the much lower reaction rates observed in aqueous pyridine, this medium is preferred to aqueous alkali, because the latter invariably gives lower yields because of partial saponification of the acetate group at C-6.
5. Compounds also bearing 3-O-acetyl groups are inclined to O-3→O-4 acetyl migrations following the O-4→O-6 migrations.

In view of the results of this and prior investigations in this field, [12] O-acetyl migrations in partially O-acetylated hexopyranosides present the following pattern. With the exception of O-4→O-6 acetyl migrations, which are found to be practically irreversible, migrations involving endocyclic positions proceed in both directions with indications that the equilibration parallels

the differences in nucleophilicities of the hydroxyl functions at C-2, C-3, and C-4. The results obtained in various base catalyzed alkylations of partially O-acetylated hexopyranosides [13] are in good agreement with this picture.

EXPERIMENTAL

Melting points were determined with a Tottoli apparatus and are uncorrected. Optical rotations were measured with a Perkin-Elmer 141 polarimeter. TLC was performed on silica gel 60 F_{254} precoated plates (Merck 5554), column chromatography on silica gel 60, 230-400 mesh (Merck 9385). [14] ^1H NMR spectra were recorded with a Bruker WH-90 DS instrument.

General Procedures

N-t-Butoxycarbonylation: To a vigorously stirred solution of 0.01 mol of aminodeoxy sugar in 5 ml of water and 30 ml methyl sulfoxide at 60 °C, 1.1 equivalents of t-butyl dicarbonate for every amino group were added. After 15 min, the mixture was diluted with 30 ml methyl sulfoxide and kept at 60 °C until reaction was complete (TLC, 6 to 10 h). After evaporation of the solvents in vacuo, the residue was stirred with ethyl ether (300 ml) overnight and the crystalline solid collected by filtration; yields were over 90%.

Tritylation, Acetylation, and Detritylation: A 5% solution of the N-protected aminodeoxy sugar and 1.2 equivalents of trityl chloride in absolute pyridine is kept at 60 °C until no starting material can be detected by TLC. After cooling to ambient temperature and addition of 1.2 equivalents of acetic anhydride for each hydroxyl group, the mixture is set aside for 24 h. After evaporation of the solvent in vacuo, dissolution in 200 ml dichloromethane, and consecutive extraction with 2% aqueous HCl and water, the organic layer after drying over Na_2SO_4 is ready for detritylation as described. [15] For the purpose of cha-

TABLE 2. Elemental Analyses Data

	Compound		% C	% H	% N	% Other
Calcd.	3, 4, 5, 6	$C_{16}H_{27}NO_9$	50.92	7.21	3.71	
Found	3		50.76	7.32	3.82	
	4		50.80	7.35	3.77	
	5		50.86	7.28	3.84	
	6		50.73	7.29	3.87	
Calcd.	7, 8	$C_{48}H_{78}N_4O_{24}$	52.64	7.18	5.12	
Found	7		52.68	7.27	5.03	
	8		52.53	7.25	4.98	
Calcd.	12	$C_{23}H_{28}O_7$	66.33	6.78		
Found	12		66.25	6.84		
Calcd.	13, 14	$C_{22}H_{24}INO_6$	50.30	4.60	2.67	I: 24.15
Found	13		50.21	4.68	2.76	I: 24.68
	14		50.16	4.57	2.58	I: 24.37
Calcd.	15, 16	$C_{16}H_{20}BrNO_6$	47.78	5.01	3.48	Br: 19.86
Found	15		47.64	5.09	3.53	Br: 20.07
	16		47.72	5.14	3.61	Br: 20.22

racterization a chromatographic purification (toluene/ethyl acetate, 1:1) is performed.

O-4→O-6 Acetyl Migration

Method A (Pyridine - Water): A 10% pyridine solution of the detritylated product, purified by chromatography, is diluted with an equal volume of water and kept at ambient temperature until equilibrium is reached. The periods vary from a few hours to a few days depending on the substrate and the state of its purity. Unless products separate on dilution with water, the reaction mixture is evaporated to dryness and the residue is dissolved in dichloromethane followed by consecutive extraction with 2% aqueous HCl, $NaHCO_3$, and water. After evaporation of the Na_2SO_4-dried solution, purification is achieved by either crystallization or chromatography (toluene/ethyl acetate, 1:2).

Method B (Aqueous-Ethanolic Alkali): To a vigorously stirred 10% solution of 0.01 mol of the detritylated product in ethanol, 0.1 N aqueous NaOH was added in 100 µl portions followed by TLC examination after each addition. The single migration steps proceed within seconds and the reaction is quenched by addition of acetic acid as soon as more polar products are detectable. After evaporation, the residue is dissolved in dichloromethane, cooled, filtered and the solvent evaporated prior to chromatography.

Methyl 2,4-Di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-glucopyranoside (3) was obtained from methyl 3-amino-3-deoxy-ß-D-glucopyranoside [16] via methyl 3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-glucopyranoside [mp 153-155 °C, $[\alpha]_D^{20}$ -9.0° (c = 1.12, pyridine)] and methyl 2,4-di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-6-O-trityl-ß-D-glucopyranoside [mp 92-94 °C, $[\alpha]_D^{20}$ + 23.0° (c = 1, $CHCl_3$)]. Overall yield 74%; mp 70-72 °C, $[\alpha]_D^{20}$ + 22.2° (c = 0.45, $CHCl_3$); ^1H NMR ($CDCl_3$) δ 1.40 (s, 9, $(CH_3)_3COCO$),

2.07 (s, 6, 2 $\underline{CH_3}CO_2$), 2.55 (bs, 1, O-$\underline{H}$), 3.50 (s, 3, $\underline{CH_3}$-O), 3.65 (m, 2, $\underline{H}$-6,6'), 4.46 (d, 1, $\underline{H}$-1, $J_{1,2}$ 8 Hz).

Methyl 2,4-Di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-galactopyranoside (5). Starting from methyl 3-amino-3-deoxy-ß-D-galactopyranoside [16] the same reaction sequence described in the general procedures was applied. This procedure produced the intermediates methyl 3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-galactopyranoside [mp 188-192 °C, $[\alpha]_D^{20}$ + 61.4° (c = 1.1, pyridine)] and methyl 2,4-di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-6-O-trityl-ß-D-galactopyranoside [mp 102-104 °C, $[\alpha]_D^{20}$ - 34.3° (c = 1.05, $CHCl_3$)], and the product 5, mp 169-171 °C, $[\alpha]_D^{20}$ - 11.8° (c = 0.9, $CHCl_3$), ^{1}H NMR ($CDCl_3$) δ 1.42 (s, 9, $(\underline{CH_3})_3COCO$), 2.10 and 2.21 (s each, 3 each, 2 $\underline{CH_3}CO_2$), 3.53 (s, 3, $\underline{CH_3}$-O), 3.6 (m, 3, $\underline{H}$-6,6' and O-$\underline{H}$), 4.46 (d, 1, $\underline{H}$-1, $J_{1,2}$ 8 Hz), in 72% yield.

2',3',4',2",4"-Penta-O-acetyl-tetra-N-t-butoxycarbonylkanamycin A (7) was obtained from kanamycin A [17] via tetra-N-t-butoxycarbonylkanamycin A [mp 227-230 °C (decomp), $[\alpha]_D^{20}$ + 78.5° (c = 1.5, pyridine)], and 2',3',4',2",4"-penta-O-acetyl-tetra-N-t-butoxycarbonyl-6"-O-tritylkanamycin A [mp 132-135 °C, $[\alpha]_D^{20}$ + 89.2° (c = 2.3, $CHCl_3$)] by employing the general procedures described above. The overall yield was 77%, mp 141-143 °C, $[\alpha]_D^{20}$ + 74.9° (c = 1.3, $CHCl_3$); ^{1}H NMR ($CDCl_3$) δ 1.43 (s, 36, 4 $(\underline{CH_3})_3COCO$), 1.99, 2.01, 2.06, 2.09, and 2.14 (s each, 3 each, 5 $\underline{CH_3}CO_2$).

Benzyl 3-O-Acetyl-2-benzamido-2,6-dideoxy-6-iodo-α-D-glucopyranoside (13). Tritylation of benzyl 2-benzamido-2-deoxy-α-D-glucopyranoside [18, 10] followed by acetylation according to the general procedures gave benzyl 3,4-di-O-acetyl-2-benzamido-2-deoxy-6-O-trityl-α-D-glucopyranoside [19] [mp 169-170 °C, $[\alpha]_D^{20}$ + 112.7° (c = 1, $CHCl_3$)]. This product after detritylation [19] [mp 136 °C, $[\alpha]_D^{20}$ + 137.1° (c = 1.03, $CHCl_3$)] was treated with triphenyl phosphite/methyl iodide [20] for 1 h at 50 °C to give benzyl 3,4-di-O-acetyl-2-benzamido-2,6-dideoxy-6-iodo-α-D-

glucopyranoside [mp 157-158 °C, $[\alpha]_D^{25}$ + 108.0° (c = 1.4, $CHCl_3$)]. After de-O-acetylation with sodium methoxide in methanol, benzyl 2-benzamido-2,6-dideoxy-6-iodo-α-D-glucopyranoside [mp 162-163 °C, $[\alpha]_D^{25}$ + 68.4° (c = 0.77, $CHCl_3$)] was obtained. Its selective acetylation with equimolar amounts of acetyl chloride in the presence of pyridine and dichloromethane at room temperature gave the title compound 13, mp 146-147 °C, $[\alpha]_D^{25}$ + 81.6° (c = 3.2, $CHCl_3$), ^{1}H NMR ($CDCl_3$) δ 1.96 (s, 3, CH_3CO_2), 4.0 (m, 1, O-H), 4.64 (ABq, 2, CH_2Ph), 5.02 (d, 1, H-1, $J_{1,2}$ 3.6 Hz), 6.57 (d, 1, N-H, $J_{2,NH}$ 9 Hz), 7.25-7.7 (m, 10, $PhCH_2$ and PhCO), in 52% overall yield.

In order to prove the structure, compound 13 was also prepared from benzyl 3-O-acetyl-2-benzamido-2-deoxy-α-D-glucopyranoside [18] by treatment with triphenyl phosphite/methyl iodide as described above, yield 25%.

Methyl 3-O-Acetyl-2-benzamido-6-bromo-2,6-dideoxy-α-D-glucopyranoside (15). Starting from methyl 2-benzamido-2-deoxy-α-D-glucopyranoside [21] methyl 2-benzamido-6-bromo-2,6-dideoxy-α-D-glucopyranoside [mp 161-162 °C (decomp), $[\alpha]_D^{25}$ + 65.8° (c = 1.73, $CHCl_3$)] was obtained by reaction with N-bromosuccinimide/triphenyl phosphane. [22] Selective acetylation as described above afforded compound 15, mp 189-190 °C (decomp), $[\alpha]_D^{25}$ + 76.4° (c = 1.14, $CHCl_3$), ^{1}H NMR ($CDCl_3$) δ 2.05 (s, 3, CH_3CO_2), 2.8 (bs, 1, O-H), 3.44 (s, 3, CH_3-O), 3.8 (m, 2, H-6,6'), 4.87 (d, 1, H-1, $J_{1,2}$ 3.6 Hz), 6.48 (d, 1, N-H, $J_{2,NH}$ 9.5 Hz), 7.4-7.8 (m, 5, PhCO), in an overall yield of 62%.

For the compounds involved in acetyl migration R_F-values as well as the ratio of toluene/ethyl acetate are given in parantheses.

Benzyl 3,6-Di-O-acetyl-2-benzamido-2-deoxy-ß-D-glucopyranoside (2). This compound (0.60, 1:2), previously obtained from an acetyl migration of 1 (0.47, 1:2) in pyridine - water [10] (93%), was also prepared by procedure B

in 77% yield after chromatography (toluene/ethyl acetate, 2:1).

Methyl 2,6-Di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-glucopyranoside (4) and Methyl 2,6-Di-O-acetyl-3-amino-3-N-t-butoxycarbonyl-3-deoxy-ß-D-galactopyranoside (6). These compounds are obtained from 3 (0.43, 1:2) and 5 (0.45, 1:2), respectively, by procedure A (2 days) in quantitative crude yields. After recrystallization from acetone/water (1:1) the yield for both 4 [0.60, 1:2, mp 166-167 °C, $[\alpha]_D^{20}$ - 15.9° (c = 0.85, $CHCl_3$), ^1H NMR ($CDCl_3$) δ 1.43 (s, 9, $(\underline{CH_3})_3COCO$), 2.10 (s, 6, 2 $\underline{CH_3}CO_2$), 2.15 (bs, 1, O-H), 3.48 (s, 3, $\underline{CH_3}$-O), 4.38 (m, 2, H-6,6')] and 6 [0.63, 1:2, mp 123-124 °C, $[\alpha]_D^{20}$ - 5.0° (c = 1, $CHCl_3$), ^1H NMR ($CDCl_3$) δ 1.42 (s, 9, $(\underline{CH_3})_3COCO$), 2.08 and 2.10 (s each, 3 each, 2 $\underline{CH_3}CO_2$), 2.8 (bs, 1, O-H), 3.50 (s, 3, $\underline{CH_3}$-O), 4.30 (m, 2, H-6,6')] is 95%.

With procedure B yields of 4 and 6 after chromatography are 83 and 84%, respectively.

2',3',4',2",6"-Penta-O-acetyl-tetra-N-t-butoxycarbonylkanamycin A (8). Compound 7 (0.42, 1:2) shows identical behavior to 3 and 5 in both procedures. Application of method A and recrystallization from dichloromethane - cyclohexane yields 95% of 8 (0.52, 1:2), while method B gives 88% of the title compound, mp 156-160 °C, $[\alpha]_D^{20}$ + 90.1° (c = 0.95, $CHCl_3$), ^1H NMR ($CDCl_3$) δ 1.43 (bs, 36, 4 $(\underline{CH_3})_3COCO$), 2.00,2.02, 2.04, 2.10, and 2.16 (s each, 3 each, 5 $\underline{CH_3}CO_2$), after chromatography.

Methyl 2,3,6-Tri-O-acetyl-α-D-glucopyranoside (10). Independent of the migration conditions applied to 9 [3] (0.47, 1:2), compound 10 (0.61, 1:2) needs to be separated from the respective equilibrium mixture by chromatography (toluene/ethyl acetate, 2:3); yields are 73% (method A) and 76% (method B). Sirup, $[\alpha]_D^{20}$ + 100.8° (c = 3.08, $CHCl_3$). - Treatment of 10 with 1 molar excess of 4-bromobenzene sulphonyl chloride in the presence of pyridine at 50 °C overnight gave a brosylate, which after reaction

with sodium acetate (5 mol/mol) in dimethyl formamide at 100 °C for 4h followed by de-O-acetylation using sodium methoxide in methanol gave methyl α-D-galactopyranoside; its structure was proved by ^{13}C NMR.[23]

Methyl 6-O-Acetyl-2,3-di-O-benzyl-ß-D-glucopyranoside (12). By applying general acetyl migration procedure A to 11[10] (0.60, 1:2), compound 12 (0.79, 1:2) crystallizes from aqueous pyridine. The yields are 68% after 24 h, 79% after 72 h. An additional crop of 9% can be obtained from the mother liquors after usual work-up and chromatography (toluene/ethyl acetate, 1:1).

When the reaction mixture, obtained by procedure B, is subjected to chromatography as described above, 12 is obtained in a yield of 74%, mp 122-124 °C, $[\alpha]_D^{20}$ - 26.8° (c = 1.33, $CHCl_3$) after recrystallization from cyclohexane. ^1H NMR ($CDCl_3$) δ 2.08 (s, 3, $\underline{CH_3}CO_2$), 2.66 (bs, 1, O-H), 3.57 (s, 3, $\underline{CH_3}$-O), 4.34 (m, 3, H-1,6,6'), 4.82 (ABq, 4, 2 $Ph\underline{CH_2}$, J_{AB} 12 Hz), 7.34 (s, 10, 2 $Ph\underline{CH_2}$).

Benzyl 4-O-Acetyl-2-benzamido-2,6-dideoxy-6-iodo-α-D-glucopyranoside (14). From the equilibrium mixture obtained by storing compound 13 (0.56, 1:1) in pyridine - water for three days, starting material 13 (68%) and 14 [23%; 0.47, 1:1; mp 149-150 °C, $[\alpha]_D^{25}$ + 69.7° (c = 0.92, $CHCl_3$), ^1H NMR ($CDCl_3$) δ 2.13 (s, 3, $\underline{CH_3}CO_2$), 3.64 (m, 1, O-H), 4.74 (m, 2, $Ph\underline{CH_2}$), 5.02 (d, 1, H-1, $J_{1,2}$ 3.6 Hz), 6,5 (d, 1, N-H, $J_{2,NH}$ 9 Hz), 7.3-7.7 (m, 10, $Ph\underline{CH_2}$ and PhCO)] were obtained by chromatography (toluene/ethyl acetate, 1:1).

Methyl 4-O-Acetyl-2-benzamido-6-bromo-2,6-dideoxy-α-D-glucopyranoside (16). Under the conditions described above, compound 15 (0.51, 1:1) gave the corresponding 4-acetate 16 (0.38, 1:1) in 21% yield; mp 184-185 °C, $[\alpha]_D^{20}$ + 67.5° (c = 0.96, $CHCl_3$), ^1H NMR ($CDCl_3$) δ 2.14 (s, 3, $\underline{CH_3}CO_2$), 2.89 (d, 1, O-H, $J_{2,OH}$ 5 Hz), 3.50 (s, 3, $\underline{CH_3}$-O), 3.8 (m, 2, H-6,6'), 4.91 (d, 1, H-1, $J_{1,2}$ 3.6 Hz), 6.53 (m, 1, N-H), 7.4-7.8 (m, 5, PhCO); 71% of starting material were recovered.

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