

Synthesis of some Branched Trisaccharides using Photolabile *o*-Nitrobenzylidene Acetals as Temporary Protecting Groups

By P. M. COLLINS* and V. R. N. MUNASINGHE

(Department of Chemistry, Birkbeck College, University of London, Malet Street, London WC1E 7HX)

Summary Methyl 2-*O*-(β -D-glucopyranosyl)-3-*O*-(β -D-glucopyranosyl)- α -L-fucopyranoside (4), methyl 2-*O*-(β -D-galactopyranosyl)-3-*O*-(β -D-galactopyranosyl)- α -L-fucopyranoside (5), and methyl 3-*O*-(β -D-glucopyranosyl)-4-*O*-(β -D-glucopyranosyl)- α -L-rhamnopyranoside (9) have been synthesised using *o*-nitrobenzylidene acetals as photosensitive temporary protecting groups.

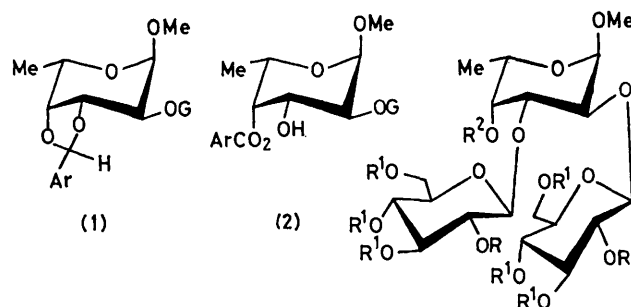
BRANCHED oligosaccharides are currently of interest because of their importance as the antigenic determinants in microbial and blood-group polysaccharides.^{1,2} Synthesis of these compounds requires that the sugar at the branch point be constructed from an aglycone blocked with temporary and permanent protecting groups³ which permit sequential glycosylation at a preselected hydroxy-group. Several approaches have been made⁴ to solve this problem and in this communication⁵ we show, with model compounds, that the *o*-nitrobenzylidene group, which we studied earlier,⁶ serves this purpose well.

Glucosylation⁷ of methyl 3,4-*O*-*o*-nitrobenzylidene- α -L-fucopyranoside⁸ with acetobromoglucose in a mixture of benzene and nitromethane containing mercury(II) cyanide gave the disaccharide (1)† in 80% yield with a β -(1→2) link as determined from the $J_{1,2}$ value in the ¹H n.m.r. spectrum of the deblocked methyl glycoside of the disaccharide. U.v. irradiation of (1) in methanol followed by mild oxidation with trifluoroperacetic acid in dichloromethane at 0 °C as described earlier⁶ gave, in 95% yield, the partially protected disaccharide (2) with a free hydroxy-group at C(3) and an *o*-nitrobenzoyl residue at O(4) as indicated by the lowfield resonance for H(4) at δ 5.3, dd, $J_{4,3}$ 3.0 and $J_{4,5}$ 1.0 Hz.

The disaccharide (2) could be glucosylated without prior recourse to chromatography, and upon condensation with acetobromoglucose it gave, in 75% yield, a 7:1 mixture of $\beta\beta$ - and $\alpha\beta$ -linked trisaccharides which was fractionated chromatographically to give the pure $\beta\beta$ -linked compound (3), m.p. 92–94 °C, $[\alpha]_D^{25}$ –12°. The ¹H n.m.r. spectrum clearly showed resonances for the Ac, OMe, CMe and HCOCOAr hydrogens and the ¹³C n.m.r. spectrum exhibited three clean signals for the anomeric carbons.

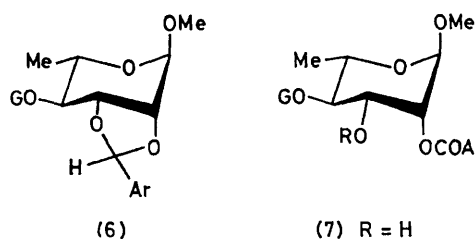
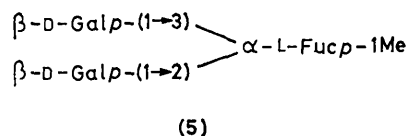
Deacylation gave the methyl glycoside (4) of the branched trisaccharide, m.p. 143–145 °C, $[\alpha]_D^{25}$ –57.1°, the anomeric protons of which resonated at δ (D₂O) 5.08, 4.75, and 4.72 ($J_{1,2}$ 2.4, 7.9, and 7.3 Hz respectively), and the protons of the OMe and CMe residues resonated respectively at 3.54(s) and 1.40(d, J 6.3 Hz). The ¹³C n.m.r. spectrum corroborated these results, with the anomeric carbons resonating at δ (D₂O) 101.4, 100.4, and 98.3 p.p.m. and the carbons of the *O*- and *C*-methyl groups at 55.8 and 16.1 p.p.m. respectively.

† All new compounds gave satisfactory elemental analyses. Unless stated otherwise optical rotations are for chloroform solution and ¹H n.m.r. spectra were measured at 200 MHz in CDCl₃.

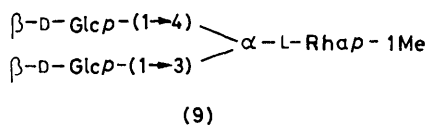


(3) R¹ = Ac, R² = ArCO

(4) R¹ = R² = H



(8) R = G



G = Tetra-*O*-acetyl- β -D-glucopyranosyl
Ar = *o*-O₂NC₆H₄

A similar series of transformations with acetobromogalactose and methyl 3,4-*O*-*o*-nitrobenzylidene- α -L-fucoside yielded the trisaccharide (5), m.p. 157–159 °C, $[\alpha]_D^{25}$ –58.2° (MeOH), δ_H (D₂O 400 MHz) 4.73, 4.76, and 5.16 ($J_{1,2}$ 7.3, 7.5, and 3.0 Hz respectively) for the anomeric protons, 3.61(s, OMe), and 1.47 (d, J 6.5 Hz, CMe); δ_C 102.1, 101.1, and 98.6 p.p.m. for the anomeric carbons, 55.3(OMe), and 16.1(CMe) p.p.m.

Trisaccharides with branching at rhamnose can also be prepared by this approach. Thus, condensing methyl 2,3-*O*-*o*-nitrobenzylidene- α -L-rhamnopyranoside⁸ with aceto-

bromoglucose afforded in 85% yield the disaccharide (6) with the β -configuration as shown by the $J_{1,2}$ value of 7.5 Hz in the ^1H n.m.r. spectrum of the partially deblocked disaccharide. Irradiation of (6) in methanol containing 4% acetic acid followed by oxidation gave, after chromatography, the disaccharide (7) (60%), m.p. 185 °C, $[\alpha]_D^{23}$ -49.9° , δ 5.32 (q, $J_{2,1}$ 1.3 and $J_{2,3}$ 3.5 Hz), characteristic of a nitrobenzoyl group at $O(2)$ of the rhamnose ring.

Glucosylation of the equatorial 3-hydroxy-group of (7) with acetobromoglucose gave, after chromatography, the tri-

saccharide (8) in 70% yield, m.p. 85–87 °C, $[\alpha]_D^{24}$ -28.7° , from which the deblocked trisaccharide methyl glycoside (9) was readily obtained in 95% yield, δ_H (D_2O) 1.57 (d, J 5.7 Hz, CMe), 3.49(s, OMe), 4.89, 4.91, and 5.03 (3d, $J_{1,2}$ 7.3, 1.9, and 7.8 Hz, respectively, for the three anomeric protons); δ_C 17.8, 55.6, 101.3, 103.4, and 104.4 p.p.m.

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⁵ Part of this work was described at the Spring Meeting of The Chemical Society Carbohydrate Group, Reading, April, 1980.

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