

Synthesis of C-Glycopyranosides by Photochemically Induced Addition of Methanol to Pyran-3-ulose

By DAVID L. WALKER and BERT FRASER-REID*

(Chemistry Department, University of Waterloo, Waterloo, Ontario, Canada)

and JOHN K. SAUNDERS

Département de Chimie, Université de Sherbrooke, Sherbrooke, P.O., Canada)

Summary Photochemically induced addition of methanol to pyran-3-uloses affords a ready method of extending the pyranose ring at C-1.

EXTENSION of a saccharide nucleus at the anomeric centre by addition of a functionalised carbon unit is useful synthetically, in view of the many C-glycosyl compounds.¹ Current methods involve either the displacement of a glycosyl halide by a variety of nucleophiles,² adaptations of the oxo-reaction,³ or photochemical addition of dioxolan to

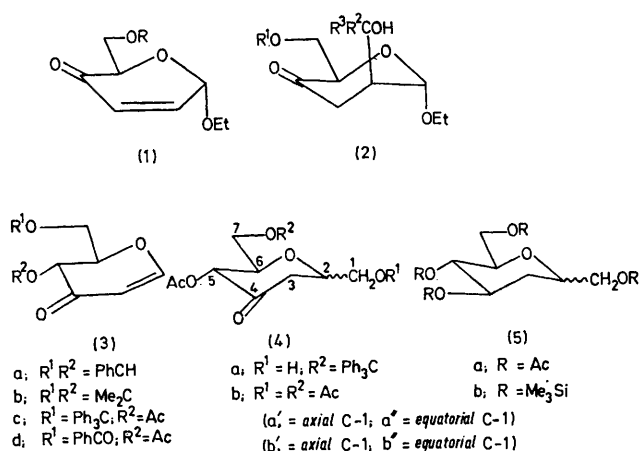
glycals.⁴ We report herein an alternative approach to this synthetic problem which is simple experimentally (*cf.* ref. 3) and does not give unwanted side products (*cf.* ref. 4a).

It was shown recently that sensitised irradiation of compound (1) in alcoholic solvents gave the carbinols (2)† in 70% yield. Dihydro- γ -pyrones such as (3) were therefore examined, since the derived carbinols would be C-glycosides.

Irradiation of (3a)⁷ in methanol did afford material which contained a primary carbinol since it reacted with tri-

† The branch in (2) is axial—not equatorial as originally thought⁵ since tosylation of the methanol adduct (2; R¹ = CPh₃; R² = R³ = H) and treatment with diazabicyclononane gave the known⁶ D-lyxo cyclopropyl ketone.

phenylmethyl chloride at ambient temperature. However, the yield was disappointingly small, and the analogue (3b)⁸



gave even lower yields. However the conformationally mobile substrates (3c) and (3d)⁸ were more satisfactory.

Compound (3c)⁸ (2.0 g) in methanol was irradiated in a Rayonet reactor at 350 nm under a constant stream of nitrogen, in the presence of benzophenone (320 mg) for 10 h. After evaporation, the residue was fractionated on a silica column whereupon 1.3 g (60%) of a substance (*m/e* 460) was isolated. Although it appeared homogeneous on t.l.c., it was judged to be a mixture by the wide m.p. 157—165°. This conclusion was supported by the presence in the n.m.r. spectrum of two overlapping doublets around δ 5.5, assignable to 5-H of the mixture (4a).

‡ We are grateful to Dr. A. Saxena of Schering Corp., Bloomington, Indiana, for suggesting this technique.

§ This compound gave satisfactory elemental and mass spectral analysis.

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⁴ (a) K. Matsuura, S. Maeda, Y. Araki, Y. Ishido, and A. Murai, *Tetrahedron Letters*, 1970, 2869; (b) K. Matsuura, K. Nishiyama, K. Yamada, Y. Araki, and Y. Ishido, *Bull. Chem. Soc. Japan*, 1973, **46**, 2538.

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⁶ B. Fraser-Reid and B. J. Carthy, *Canad. J. Chem.*, 1972, **50**, 2928.

⁷ P. M. Collins, *Carbohydrate Res.*, 1969, **11**, 125.

⁸ B. Fraser-Reid, D. L. Walker, S. Y-K. Tam, and N. L. Holder, *Canad. J. Chem.*, 1973, **51**, 3950.

⁹ J. B. Stothers, 'Carbon-13 NMR Spectroscopy,' Academic Press, New York, 1972, ch. 3.

Resolution was achieved on a column of t.l.c. silica gel, ‡ (20 × 2.5 cm) the axial (4a') and equatorial (4a'') components being obtained in 7:3 ratio. For (4a'), § m.p. 175—177° [α]_D²³ + 293.4 (*c*, 1.85 in CHCl₃). For (4a''), § m.p. 171—173° [α]_D²³ + 168.2 (*c*, 1.46 in CHCl₃).

Critical evidence in support of the assigned structures were obtained from n.m.r. spectra in CDCl₃ (Me₄Si): ¹H n.m.r., δ (4a') 2.94 (*J*_{gem} 14; *J*_{2,3a} 7 Hz, 3a-H), and 2.53 (*J*_{2,3e} 2.5 Hz, 3e-H); δ (4a'') 2.72 (*J*_{gem} 14; *J*_{2,3a} = 12.0 Hz, 3a-H), and 2.58 (*J*_{vic} 2.8 Hz, 3e-H). In the ¹³C n.m.r. spectra C-2, -3, and -5 which are α , β , and δ , respectively, to C-1 should be more shielded in the axial than in the equatorial adduct.⁹ Accordingly in the derived triacetates the resonances are 72.4, 41.6, and 73.0 p.p.m. respectively for (4b') and in (4b'') 75.2, 43.5, and 77.2.

The relative values of the optical rotations for the anomers (4a) obey Hudson's rules of isorotation, as do those for the related series, (5a). However, the absolute values for the latter are very much smaller than those of (4a). A strong effect of the dissymmetry of C-3 upon the optical rotations of these molecules therefore seems to be implied.

The series (4) and (5) were correlated by NaBH₄ reduction of (4a') and (4a'') followed by acid hydrolysis. In each case the resulting tetraol was converted into the trimethylsilyl derivative and identified (g.l.c.) with authentic samples of (5b') and (5b'').³

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