

The Solvolysis of Methyl 2,3-Di-*O*-methyl-6-*O*-methylsulphonyl- β -D-galactopyranoside: a Methoxy-group Participation

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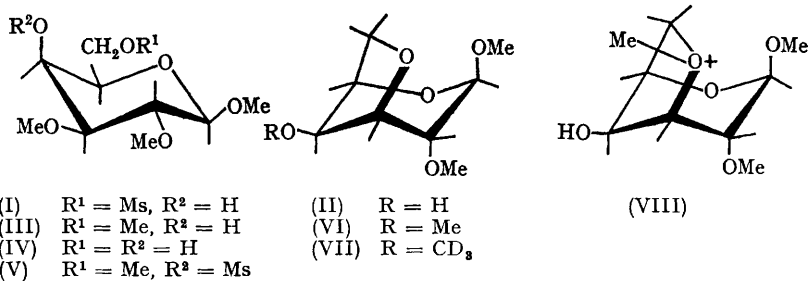
EXAMPLES of methoxy-group participation in nucleophilic displacements of carbohydrate sulphonates and halides are comparatively rare and, in all reported cases,¹ the participating methoxy-group is substituted at C-1. The cyclic oxonium ion intermediates are opened preferentially at C-1 with consequent migration of the methoxy-group. We report an example of neighbouring group participation by a methoxy-group which is substituted at C-3 of a pyranoid ring.

Solvolysis of methyl 2,3-di-*O*-methyl-6-*O*-methylsulphonyl- β -D-galactopyranoside† (I), m.p. 84—86°, $[\alpha]_D -11^\circ$ (*c* 2, CHCl₃), in boiling 50% aqueous methanol in the presence of sodium acetate for 96 hr., afforded three products which were separated by chromatography over silica gel and identified as methyl 3,6-anhydro-2-*O*-methyl- β -D-galactopyranoside (II, 32%), m.p. 46—47°, $[\alpha]_D -85^\circ$ (*c* 0.5, CHCl₃), methyl 2,3,6-tri-*O*-methyl- β -D-galactopyranoside (III, 18%), $[\alpha]_D -22^\circ$ (*c* 0.6,

CHCl₃), and methyl 2,3-di-*O*-methyl- β -D-galactopyranoside (IV, > 26%), $[\alpha]_D$ *ca.* 0° (*c* 2.5, MeOH). Compounds (III) and (IV) were readily identified by comparison with authentic samples^{2,3} and they were further characterised as the crystalline 4-*O*-methylsulphonate (V), m.p. and mixed m.p. 141—142°, and 6-*O*-methylsulphonate (I), m.p. and mixed m.p. 84—86°. The anhydro-sugar (II) was identified by elemental analyses and n.m.r. spectroscopy, which demonstrated the presence of two methoxy-groups, and also by its conversion into methyl 3,6-anhydro-2,4-di-*O*-methyl- β -D-galactopyranoside⁴ (VI) on methylation. This assignment was supported by mass spectrometry of the derived methyl ether (VI) and the trideuterio-methylated analogue (VII). Prominent fragmentations⁵ of permethylated 3,6-anhydropyranosides (e.g., VI) on electron impact are those leading to

ions of m/e 101 (MeOCH—CH=CHOMe) and 71

† All new compounds gave satisfactory elemental analyses, and n.m.r. and i.r. spectra.



($\text{MeOCH}-\text{CH}=\text{CH}_2$), which contain carbon atoms 2—4 and 4—6 of the parent sugar, respectively. The mass spectrum of the deuteriated compound (VII) contained peaks at m/e 176 ($M - 31$), 104 ($\text{MeOCH}-\text{CH}=\text{CHOCD}_3$), and 74 ($\text{CD}_3\text{OCH}-\text{CH}=\text{CH}_2$) which identify the 4-hydroxy-group as the site of trideuteriomethylation and, hence, structure (II) for the parent anhydro-sugar.

Anhydro-sugar (II) is evidently produced from the bicyclic, tertiary oxonium ion (VIII), which is

presumably formed by a methoxy-assisted solvolysis⁶ of the sulphonate (I), while compounds (III) and (IV) may have arisen from a solvent-assisted reaction or from C-6-O bond cleavage of oxonium ion (VIII) by solvent attack.⁶ Rearranged products possibly arising from C-3-O bond cleavage of oxonium ion (VIII) were not detected; an examination of molecular models revealed that the approach of nucleophiles to C-3 is sterically hindered so that solvent attack at this position is unlikely.

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¹ C. L. Stevens, R. P. Glinski, K. G. Taylor, P. Blumbergs, and F. Sirokman, *J. Amer. Chem. Soc.*, 1966, **88**, 2073; N. A. Hughes and P. R. H. Speakman, *J. Chem. Soc. (C)*, 1967, 1182; R. U. Lemieux and B. Fraser-Reid, *Canad. J. Chem.*, 1964, **42**, 539.

² N. R. Williams and R. W. Jeanloz, *J. Org. Chem.*, 1964, **29**, 3434.

³ D. J. Bell, *Adv. Carbohydrate Chem.*, 1951, **6**, 11.

⁴ W. N. Haworth, J. Jackson, and F. Smith, *J. Chem. Soc.*, 1940, 620.

⁵ K. Heyns and M. Scharmann, *Carbohydrate Res.*, 1966, **1**, 371.

⁶ E. Allred and S. Winstein, *J. Amer. Chem. Soc.*, 1967, **89**, 3991 and following papers.