Exocyclic Acyloxy-group Participation in Displacement Reactions of 5-*O*-Sulphonyl-glucofuranose Derivatives

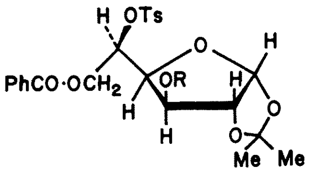
By R. C. CHALK, D. H. BALL,* M. A. LINTNER, and L. LONG, JUN.

(*Pioneering Research Laboratory, U.S. Army Natick Laboratories, Natick, Massachusetts* 01760)

Summary The reactions of 6-*O*-benzoyl-1,2-*O*-isopropylidene-5-*O*-tosyl-D-glucofuranose derivatives with acetate or chloride ions in boiling acetic anhydride involve participation by the neighbouring benzoyloxy-group in the displacement of the tosyloxy-group.

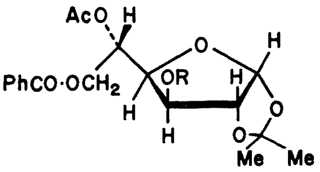
ALTHOUGH it has been assumed[1-3] that acyloxy-group participation is absent in displacement reactions of 6-*O*-acyl-5-*O*-sulphonyl-glucofuranose derivatives, no experiments have been reported which would determine the mechanism of such displacements. We report our results which demonstrate neighbouring-group participation by a C-6 benzoyloxy-group in displacements of C-5 tosyloxy-groups of D-glucofuranose derivatives.

Treatment of 6-*O*-benzoyl-1,2-*O*-isopropylidene-3,5-di-*O*-tosyl-α-D-glucofuranose (I)[4] with the acetate form of Dowex 1 ion exchange resin in boiling acetic anhydride gave a crystalline product, m.p. 125·5—126·5°, $[\alpha]_D$ −8° (*c* 1·0, $CHCl_3$), in high yield as reported by Miljkovic and Davidson.[1] These authors assumed this compound to be 5-*O*-acetyl-6-*O*-benzoyl-1,2-*O*-isopropylidene-3-*O*-tosyl-β-L-idofuranose (II) which would result from an S_N2 displacement. The same compound can also be prepared in good yield from (I) on being treated with anhydrous silver acetate in boiling acetic anhydride and the following experiments prove that it is 6-*O*-acetyl-5-*O*-benzoyl-1,2-*O*-isopropylidene-3-*O*-tosyl-β-L-idofuranose (III), clearly formed by attack of acetate ion at the primary carbon of an intermediate benzoxonium ion (IV).



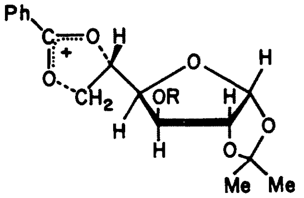
(I) R = Ts

(VIII) R = Ac



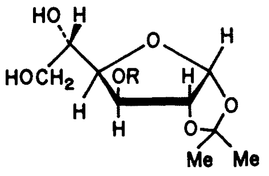
(II) R = Ts

(IX) R = Ac



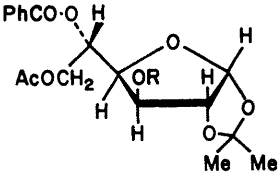
(IV) R = Ts

(XI) R = Ac



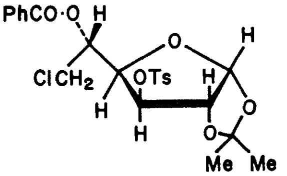
(V) R = Ts

(VI) R = H



(III) R = Ts

(X) R = Ac



(VII)

Catalytic deacylation of (III) with sodium methoxide in methanol gave 1,2-*O*-isopropylidene-3-*O*-tosyl-β-L-idofuranose (V),† m.p. 99—100°, $[\alpha]_D$ −27° (*c* 1·3, $CHCl_3$) in 91% yield. Detosylation of (V) with lithium aluminium hydride in ether afforded the known 1,2-*O*-isopropylidene-β-L-idofuranose (VI), m.p. 113—114·5°, $[\alpha]_D$ −27° (*c* 1·3, H_2O) in good agreement with reported values.[5] Selective monomolar benzoylation of (V) gave 6-*O*-benzoyl-1,2-*O*-isopropylidene-3-*O*-tosyl-β-L-idofuranose in 54% yield, m.p. 133·5—134·5°, $[\alpha]_D$ −44° (*c* 1·4, $CHCl_3$) and acetylation of this compound gave 5-*O*-acetyl-6-*O*-benzoyl-1,2-*O*-isopropylidene-3-*O*-tosyl-β-L-idofuranose (II) as a syrup, $[\alpha]_D$ −7° (*c* 1·0, $CHCl_3$). Selective monomolar acetylation of (V) gave 6-*O*-acetyl-1,2-*O*-isopropylidene-3-*O*-tosyl-β-L-idofuranose as a syrup in 50% yield, $[\alpha]_D$ −25° (*c* 1·2, $CHCl_3$) and benzoylation of this compound gave crystalline 6-*O*-acetyl-5-*O*-benzoyl-1,2-*O*-isopropylidene-3-*O*-tosyl-β-L-idofuranose (III) in 72% yield. Comparison of ^{1}H n.m.r. spectra and physical constants showed that the product obtained from (I) by acetate ion displacement was identical with (III) and different from (II).

Treatment of (I) with the chloride form of Dowex 1 ion exchange resin in boiling acetic anhydride also resulted in C-6 benzoyloxy-group participation and 5-*O*-benzoyl-6-chloro-6-deoxy-1,2-*O*-isopropylidene-3-*O*-tosyl-β-L-idofuranose (VII), $[\alpha]_D$ + 9° (*c* 1·1, $CHCl_3$), was obtained as a syrup in good yield. Treatment of (VII) with silver acetate in boiling acetic anhydride gave (III).

The reaction of 3-*O*-acetyl-6-*O*-benzoyl-1,2-*O*-isopropylidene-5-*O*-tosyl-α-D-glucofuranose (VIII) with potassium acetate in boiling acetic anhydride was also assumed to occur by S_N2 displacement and the product, m.p. 119—121°, $[\alpha]_D$ −23° (*c* 1·4, $CHCl_3$), was thought to be 3,5-di-*O*-acetyl-6-*O*-benzoyl-1,2-*O*-isopropylidene-β-L-idofuranose (IX).[2] Selective monomolar benzoylation of (VI) gave, as the major product, 6-*O*-benzoyl-1,2-*O*-isopropylidene-β-L-idofuranose, m.p. 109·5—110·5, $[\alpha]_D$ −6·4° (*c* 1·3, $CHCl_3$), and acetylation of this monobenzoate gave 3,5-di-*O*-acetyl-6-*O*-benzoyl-1,2-*O*-isopropylidene-β-L-idofuranose (IX), m.p. 86—88°, depressed to 75—85° by admixture with the acetate displacement product, $[\alpha]_D$ −15° (*c* 1·0, $CHCl_3$). The ^{1}H n.m.r. spectra of the two compounds were also different and the displacement product is therefore 3,6-di-*O*-acetyl-5-*O*-benzoyl-1,2-*O*-isopropylidene-β-L-idofuranose (X) formed *via* the intermediate benzoxonium ion (XI).

We thank the Army Research Office, Durham, North Carolina, U.S.A., for support (to R. C. C.) and Mr. F. H. Bissett for assistance with the ^{1}H n.m.r. spectra.

(*Received, December 29th*, 1969; *Com.* 1948.)

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† All new compounds gave satisfactory elemental analyses and ^{1}H n.m.r. spectra consistent with the assigned structures.

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