Selective Cleavage of Glycosidic Linkages *via* *N*-Nitrosoamide Decomposition

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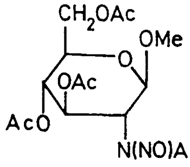
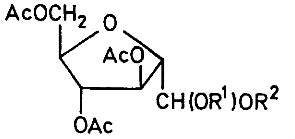
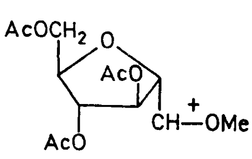
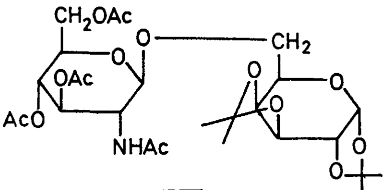
Summary Cleavage of the glycosidic linkage occurred during the decomposition, in aqueous medium, of the *N*-nitroso-derivatives of two 2-acetamido-3,4,6-tri-*O*-acetyl-2-deoxy-β-D-glucopyranosides to give 3,4,6-tri-*O*-acetyl-2,5-anhydro-D-mannose and the aglycone; in non-aqueous medium extensive denitrosation occurred and the aglycone was retained in the products of rearrangement.

DEAMINATIONS of amino-sugars and amino-sugar-containing compounds are of potential use in synthesis and structure elucidation, and the scope of such reactions is becoming clearer as more data become available[1] However, many amino-sugars occur naturally as amide derivatives and direct deamination is not then possible For this reason, we have investigated the decomposition of *N*-nitrosoamide derivatives of amino-sugars, reactions which would be expected to give similar products to deamination of the corresponding amines[2] We report herein two examples of carbohydrate nitrosoamide decomposition


(I)


(II) R^1 = Me , R^2 = Et
(III) R^1 = Me , R^2 = Ac
(IV) R^1 = R^2 = H
(V) R^1 = R^2 = Et


(VI)


(VII)

Nitrosation of methyl 2-acetamido-2-deoxy-β-D-glucopyranoside with nitrosyl chloride gave the crystalline yellow *N*-nitroso-derivative† (I), m p 87 5—88·5° in 93% yield [ν_{max} 1750 and 1520 cm^{-1} (C=O and N=O stretching, respectively), λ_{max} 428, 408, and 393 nm (ε 86, 84, and 53, respectively) τ ($CDCl_3$) 7 31 N(NO)COMe] The nitrosoamide was stable for several months at 5° in the solid state, but a chloroform solution, when stored at room temperature (20—25° decomposed slowly in twenty-five days to give a mixture of products from which the parent amide was crystallised slightly impure in 59% yield ‡ The remaining products were difficult to isolate pure because of their similar physical properties The major fraction obtained (25% by weight), after chromatography on silica gel, was found to contain the 2,5-anhydro-D-mannose derivatives (II) and (III), both hemiacetal diastereoisomers being present in each case [τ 6·54, 6 56, 6 60, and 6 62, OMe singlets ($CDCl_3$)] The major component was the hemiacetal tetra-acetate (III), the 100 MHz n m r spectrum of a fraction which was predominantly (III) being very similar to the 60 MHz spectrum reported[3] Deacetylation of a mixture of (II) and (III) gave mainly 2,5-anhydro-D-mannose, identified by comparison with an authentic sample on paper chromatograms, removal of the anhydromannose by a strong base ion-exchange resin gave, in low yield, a residue, benzoylation of which afforded syrupy 2,5-anhydro-3,4,6-tri-*O*-benzoyl-D-mannose ethyl methyl acetal [*m/e* 503§ (*M* — OMe), 489§ (*M* — OEt), 89 (MeOCHOEt), τ ($CDCl_3$) 6 52 s, and 6 53 s (OMe), 6 3 m and 8 75 m (OEt)], contaminated with benzoic anhydride (ν_{max} 1790 cm^{-1}) Two other unidentified compounds were isolated in low yield

The decomposition of (I) in 50% aqueous acetone gave, after seven days at room temperature, mainly 3,4,6-tri-*O*-acetyl-2,5-anhydro-D-mannose, which existed predominantly as its hydrate (IV) in chloroform solution (n m r evidence) ¶ This product was characterised as the diethyldithioacetal {60%, $[\alpha]^{22}_D$ + 44° ($CHCl_3$)}, diethylacetal (V) {47%, m p 54-6°, $[\alpha]^{20}_D$ + 34° ($CHCl_3$)}, and 1,1-di-*O*-acetyl{$[\alpha]^{22}_D$ + 34° ($CHCl_3$)} derivatives, which were identical with those prepared from 2,5-anhydro-D-mannose (obtained from 2-amino-2-deoxy-D-glucose hydrochloride[5]) Methyl 3,4,6 tri-*O*-acetyl-β-D-glucopyranoside was probably a minor product since methyl β-D-glucopyranoside and its tetra-acetate were detected after deacetylation and acetylation (respectively) of the crude product

The 2,5-anhydro-D-mannose derivatives (III), (II), and (IV) presumably arise by reaction of acetate (derived from the nitrosoamide[2]), ethanol (present in the chloroform), and water, respectively, with the cation (VI), which results from rearrangement of the intermediate diazonium ion The disaccharide (VII), m p 105—107° and 117—119° (dimorphs), $[\alpha]^{22}_D$ — 56 5° ($CHCl_3$), prepared by a Koenigs–Knorr reaction of 2-acetamido-3,4,6-tri-*O*-acetyl-2-deoxy-α-D-glucopyranosyl chloride with 1,2:3,4-di-*O*-isopropylidene-α-D-galactopyranose, similarly gave a syrupy *N*-nitrosoamide [ν_{max} 1760 and 1540 cm^{-1}, λ_{max} 423, 405, and 390 nm, τ ($CDCl_3$) 7·30, N(NO)COMe], which decomposed in 50% aqueous acetone to give two major products 1,2:5,6-Di-*O*-isopropylidene-α-D-galactopyranose was isolated in 58% yield and characterised as the crystalline tosylate[6] 3,4,6-Tri-*O*-acetyl-2,5-anhydro-D-mannose was characterised as the diethylacetal and diethyldithioacetal derivatives

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† All new compounds isolated had satisfactory elemental and/or spectral analyses

‡ Attempts to obtain the amide pure by recrystallisation were unsuccessful. T l c and i r analysis showed that the isolated material was mainly the parent amide

§ Confirmed by accurate mass measurements

¶ The tendency of aldehydroaldose derivatives to exist as hydrates even in chloroform solution has recently been reported[4]

[1] For recent results see (a) A K Al-Radhi, J S Brimacombe and L C N Tucker, *Chem Comm* , 1970, 1250, (b) J Defaye, T Nakamura D Horton, and K D Philips, *Carbohydrate Res* , 1971, **16**, 133, (c) N M K Ng Ying Kin, J M Williams, and A Horsington *J Chem Soc* (C) 1971, 1578
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