

Reaction of Isocyanatosulphonyl Chloride with Unsaturated Sugars. The Preparation of 3-Amino-3-deoxy-D-glucal-derivatives

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Summary Isocyanatosulphonyl chloride (3) reacts with tri-*O*-acetyl-D-glucal in ether to give 1,3,4,6-tetra-*O*-acetyl-2-*C*-(4,6-di-*O*-acetyl-2,3-dideoxy- α -D-erythro-hex-2-enopyranosyl)-2-deoxy- β -D-glucopyranose (1), and with ethyl 4,6-di-*O*-acetyl-2,3-dideoxy- α -D-erythro-hex-2-enopyranoside (2) to give an unstable product which can be reduced to 4,6-di-*O*-acetyl-3-deoxy-3-(ethoxycarbonylamino)-D-glucal (4).

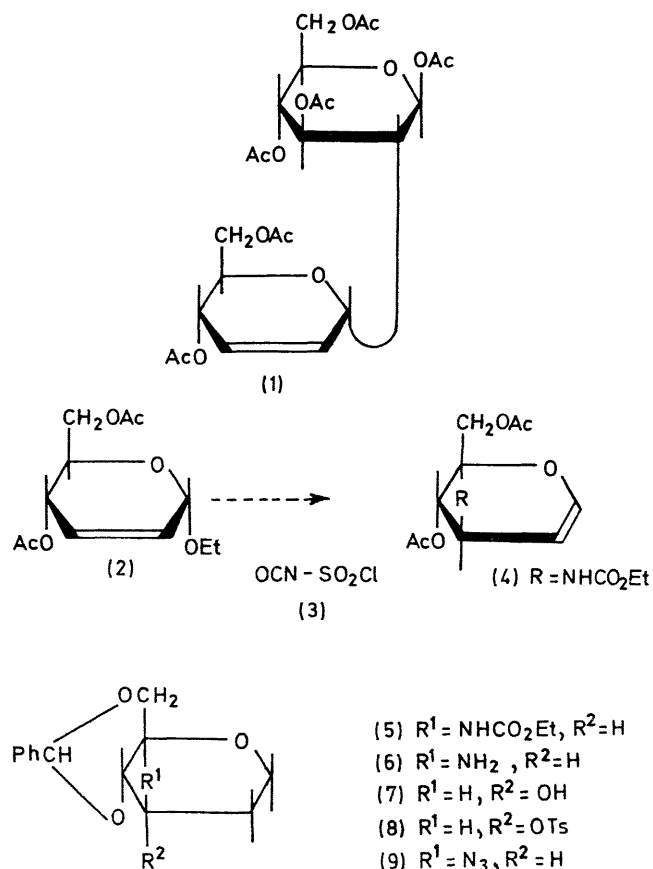
be isolated from the mixture. The *arabino*-configuration of (4) may suggest that initial attack of the ethoxy-group

A REPORT¹ on the reaction of enol ethers with isocyanatosulphonyl chloride (3) suggested that the reaction of (3) with an equimolar amount of tri-*O*-acetyl-D-glucal in diethyl ether might be used for the preparation of new branched-chain sugars. Compound (1) (50% yield), m.p. 197–201°, identical to an authentic sample prepared by the method of Ferrier and Prasad,² was the only product, indicating that (3), or the trace impurity of sulphur trioxide present in the reagent³ catalyses the dimerisation in the same way as boron trifluoride.²

The unsaturated sugar (2) reacted with an equimolar amount of (3) in ether (25°; 18 h) to give an unstable product which was reduced (KI, aqueous Na₂CO₃) to give an oil from which the 3-(ethoxycarbonylamino)-3-deoxy-D-glucal (4)† (25% yield), m.p. 113–115°, $[\alpha]_D^{25} + 68^\circ$, could be separated by chromatography on silica. Catalytic hydrogenation (Pd-C in EtOAc) of (4) gave a dihydro-derivative, m.p. 130–132°, $[\alpha]_D^{21} + 53^\circ$, which on deacetylation (NaOMe-MeOH; 25°; 18 h) and benzylidenation (140°; 1 h under CO₂), afforded (5), m.p. 186°, $[\alpha]_D^{26} - 36^\circ$. A primary amine (6), m.p. 71–73°, $[\alpha]_D^{26} - 43^\circ$ was obtained when (5) was hydrolysed (NaOMe-MeOH; sealed tube; 100°; 24 h).

The *arabino*-configuration proposed for (4) was established by an unambiguous synthesis of (5). 4,6-*O*-Benzylidene-D-allal⁴ was hydrogenated (Raney Ni, in EtOH) to give 1,5-anhydro-4,6-*O*-benzylidene-2-deoxy-D-ribohexitol (7), m.p. 118–119°, $[\alpha]_D^{29} + 22^\circ$, from which the toluene-*p*-sulphonate (8), m.p. 129–130°, $[\alpha]_D^{26} - 2^\circ$, was prepared. Treatment of (8) with sodium azide (90% aqueous DMF; 120°; 18 h under N₂) gave the azido-sugar (9) as an oil, $[\alpha]_D^{28} - 12^\circ$, which could be reduced (Zn-DMF; 18 h under N₂) to yield an oil, identical to (6) (mass spectrum and chromatography). From the reaction of this oil with ethyl chloroformate-pyridine (24 h; room temperature) crystals identical (m.p., mixed m.p., mass spectrum, and specific rotation) to (5) were obtained.

The mechanism by which (4) is formed is not clear. No external source of ethoxy-groups was present during the synthesis and isolation of (4) and no other products could



of (2) on the reagent (3), is followed by neighbouring-group participation of the C-4 acetoxy-group to expel a species like ClSO₂-N⁻-CO₂Et by an S_N2' mechanism. Compound (4) would then be formed by S_N2 attack on C-3 by the species ClSO₂-N⁻-CO₂Et. The possibility that the *arabino*-configuration is produced without neighbouring-group participation will be tested by carrying out the reaction on a derivative of (2) which has a group at position 4 that cannot participate in the reaction.

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† All new compounds had satisfactory microanalytical and spectral properties. Optical rotations were measured for solutions in chloroform (*c* 1, ±0.3%).

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