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Note

Preparation of *O*-(2-deoxy-α-D-*arabino*-hexopyranosyl)-(1 → 6)-D-glucose by the oxyiodination-hydrogenation method

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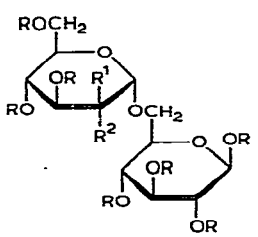
In our recent paper[1] we reported that the equimolar oxymercuration of D-glucal triacetate with 1,2,3,4-tetra-*O*-acetyl-β-D-glucopyranose in the presence of mercuric perchlorate, and subsequent demercuration of the mercurial products with sodium borohydride, afforded two isomeric disaccharides containing 2-deoxy-*arabino*-hexose. P.m.r. spectroscopic and chromatographic evidence suggested the structure of *O*-(2-deoxy-α-D-*arabino*-hexopyranosyl)-(1→6)-D-glucose for the isomer having the higher optical rotation. For the purpose of identification we have prepared a reference sample of the title compound by applying the method of Lemieux *et al.*[2].

The equimolar reaction of D-glucal triacetate, 1,2,3,4-tetra-*O*-acetyl-β-D-glucopyranose, and iodonium di-*sym*-collidine perchlorate (formed *in situ*) proceeded smoothly to give two crystalline disaccharide derivatives (**1** and **2**) in yields of 39% and 7%, respectively. These compounds were determined to be an *O*-(3,4,6-tri-*O*-acetyl-2-deoxy-2-iodo-D-mannopyranosyl)-(1→6)-1,2,3,4-tetra-*O*-acetyl-β-D-glucopyranose and an isomer having 2-deoxy-2-iodo-D-glucose at the non-reducing part, respectively, from their microanalytical data, specific rotations, and chromatographic analysis of their component sugars. Both isomers were deacetylated, and then catalytically hydrogenated to give a syrupy 2′-deoxy disaccharide (**5**). The disaccharide **5** was strongly dextrorotatory ($[\alpha]_D$ +85.2°) in contrast to the known[1] β-linked isomer ($[\alpha]_D$ +11.3°), and its p.m.r. spectrum gave a well resolved octet at τ 7.99 for H-2′*a* that displayed a small coupling (3.2 Hz) for $J_{1',2'a}$. This evidence indicated that the disaccharide **5** is α-linked, and that **5** is thus *O*-(2-deoxy-α-D-*arabino*-hexopyranosyl)-(1→6)-D-glucose. Accordingly, both of the original com-



1 R = Ac, R^1 = I, R^2 = H
2 R = Ac, R^1 = H, R^2 = I
3 R = R^2 = H, R^1 = I
4 R = R^1 = H, R^2 = I
5 R = R^1 = R^2

pounds (**1** and **2**) were considered to be also α-linked. It is noteworthy that *cis*-addition occurred in the oxyiodination of D-glucal triacetate, although in a small proportion, in contrast to the general course of oxyiodination[2–5]. The intermediate formation of a 2-substituted carbonium ion may be postulated for these oxyiodinations, by analogy with reactions of oxychlorination and oxybromination.

EXPERIMENTAL

General. — Melting points were determined on a hot stage with a Yanagimoto micro melting-point apparatus and are uncorrected. Specific rotations were measured in a 1-dm tube. P.m.r. spectra were obtained at 100 MHz with a JEOL JNM 4H-100 spectrometer, and chemical shifts are expressed on the τ-scale in p.p.m. for 10% solutions in chloroform-*d* (**1** and **2**) and in D_2O (**5**), at room temperature with tetramethylsilane as the standard. Descending paper chromatography was carried out on Whatman No. 1 filter paper with 4:1:5 butyl alcohol–acetic acid–water (upper layer, solvent *A*) and 6:4:3 butyl alcohol–pyridine–water (solvent *B*). T.l.c. was performed on glass plates (20 × 10 cm) coated with Wakogel B-5 and 30:9:1 chloroform–methanol–water as solvent system. All evaporations were effected below 40° under diminished pressure.

Oxyiodination of D-*glucal triacetate with 1,2,3,4-tetra*-O-*acetyl-β*-D-*glucopyranose.* — D-Glucal triacetate (2.72 g, 10.0 mmoles), 1,2,3,4-tetra-*O*-acetyl-β-D-glucopyranose (3.48 g, 10.0 mmoles), *sym*-collidine (1.21 g, 10.0 mmoles), and pulverized Drierite (10 g) were stirred in dehydrated benzene (250 ml) for 30 min. To this mixture was added anhydrous silver perchlorate (2.07 g, 10.0 mmoles), with continuous stirring in the dark. Immediate precipitation of the *sym*-collidine–silver perchlorate complex was observed. Iodine (1.27 g, 10.0 mmoles) was added to the reaction mixture, and stirring was continued for a further 30 min. The precipitate was filtered off and the filtrate was evaporated to dryness to give a syrup that was taken up in chloroform (250 ml). The chloroform solution was washed with 5% sodium thiosulfate, followed by saturated sodium hydrogen carbonate, and finally with water, and dried over calcium chloride. After evaporation of the solvent, a syrup was obtained that by t.l.c. gave two spots slightly more mobile than D-glucose tetraacetate, together with faint spots of unreacted reactants. The syrup was acetylated with a mixture of pyridine (75 ml) and acetic anhydride (75 ml) to convert unreacted D-glucose tetraacetate into the pentaacetate, and permit better resolution on column chromatography. The resulting syrup was applied to a column of silica gel (Mallinckrodt, 5 × 30 cm), which was eluted with benzene. Unreacted D-glucal triacetate and the D-glucose pentaacetate formed were eluted off first. Subsequently, the components on the column were fractionated carefully with dichloromethane as eluant to give two crystalline products, *O*-(3,4,6-tri-*O*-acetyl-2-deoxy-2-iodo-α-D-mannopyranosyl)-(1→6)-1,2,3,4-tetra-*O*-acetyl-β-D-glucopyranose (**1**, 2.91 g, 39%) and the α-D-glucopyranosyl isomer (**2**, 0.52 g, 7%). Recrystallization of **1** from ether afforded needles, m.p. 168–169°, $[\alpha]_D^{22}$ +25.2° (*c* 1.0, chloroform); p.m.r. data: τ 4.31

(1-proton doublet, H-1, $J_{1,2}$ 8.0 Hz), 4.5–6.5 (14 protons, ring protons), 7.90–8.02 (21 protons, OAc).

Anal. Calc. for $C_{26}H_{35}IO_{17}$: C, 41.83; H, 4.73; I, 17.00. Found: C, 42.22; H, 4.58; I, 16.84.

Recrystallization of **2** from ethanol afforded prisms, m.p. 176–178°, $[\alpha]_D^{31}$ +12.0° (*c* 1.9, chloroform); p.m.r. data: τ 4.31 (1-proton doublet, H-1, $J_{1,2}$ 8.0 Hz), 4.5–6.5 (14 protons, ring protons), 7.88–7.98 (21 protons, OAc).

Anal. Calc. for $C_{26}H_{35}IO_{17}$: C, 41.83; H, 4.73; I, 17.00. Found: C, 42.04; H, 4.88; I, 16.95.

Deacetylation of **1**. — Compound **1** (300 mg) was dissolved in aqueous methanol (1:10 *v/v*, 18 ml) containing triethylamine (2 ml), and the solution was allowed to stand overnight. The mixture was deionized by passing it through columns of Amberlite IR-120 (H^+), followed by Amberlite IRA-410 (CO_3^{2-}). The deacetylated product **3** was obtained as amorphous powder after the evaporation of solvent, followed by trituration of the residual syrup with ethanol; yield 170 mg (96%), m.p. 154–155°, $[\alpha]_D^{20}$ +51.7° (*c* 1.8, water, 24 h); R_G 1.33 (solvent *B*).

A sample of **3** was heated in 0.03M sulfuric acid for 5 h at 70°. The reaction solution was neutralized with barium hydroxide and the precipitate was centrifuged off. T.l.c. examination of the supernatant showed the presence of two components having R_F 0.04 and 0.77. D-Glucose and authentic 2-deoxy-2-iodo-D-mannose (prepared by the hydrolysis of its methyl α-glycoside[3]) had R_F 0.04 and 0.77, respectively.

Hydrogenation of **3**. — Compound **3** (150 mg) was hydrogenated at atmospheric pressure with 5% palladium on charcoal as catalyst. After filtering off the catalyst the filtrate was deionized and evaporated to dryness, to give syrupy *O*-(2-deoxy-α-D-*arabino*-hexopyranosyl)-(1→6)-D-glucose (**5**, 104 mg, 97%), $[\alpha]_D^{20}$ +85.2° (*c* 1.4, water, 24 h); R_G 0.60 (solvent *A*), 0.69 (solvent *B*); p.m.r. data: τ 7.50 (1-proton octet, H-2′*e*, $J_{1',2'e}$ 1.5 Hz, $J_{2'a,2'e}$ 13.2 Hz, $J_{2'e,3'}$ 5.0 Hz), 7.99 (1-proton octet, H-2′*a*, $J_{1',2'a}$ 3.2 Hz, $J_{2'a,3'}$ 5.0 Hz). Hydrolysis of **5** as described for **3** gave a syrup that gave two spots on paper chromatography, R_G 1.00 and 1.70 (solvent *A*); 1.00 and 1.38 (solvent *B*). The R_G values of authentic 2-deoxy-D-*arabino*-hexose with solvent *A* and solvent *B* were 1.70 and 1.38, respectively.

Deacetylation of **2**. — From compound **2** a syrupy deacetylation product **4** was obtained by the procedure used for **1**; $[\alpha]_D^{33}$ +77.2° (*c* 3.0, water, 24 h); R_G 1.52 (solvent *B*). A hydrolyzate of **4**, obtained in a similar manner as for **3**, gave two spots on t.l.c. having R_F 0.04 and 0.73. D-Glucose, and authentic 2-deoxy-2-iodo-D-glucose prepared by the hydrolysis of its methyl β-glycoside[3], had R_F 0.04 and 0.73, respectively.

Hydrogenation of **4**. — By the method used for **3**, compound **4** was hydrogenated to give a syrup, $[\alpha]_D^{30}$ +90.6° (*c* 0.6, water, 24 h); R_G 0.60 (solvent *A*), 0.69 (solvent *B*). Its p.m.r. spectrum was identical with that of **5**, and hydrolysis of this syrup gave the same result as observed with compound **5**.

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