Carbohydrate Research, 110 (1982) 330–332
Elsevier Scientific Publishing Company, Amsterdam – Printed in The Netherlands

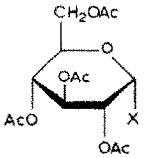
Note

A convenient preparation of some 2,3,4,6-tetra-*O*-acetyl-1,5-anhydro-D-hexitols

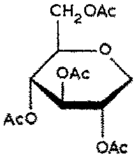
PHILIP KOCIENSKI* AND CHANDRA PANT
Department of Organic Chemistry, The University, Leeds LS2 9JT (Great Britain)

(Received March 29th, 1982; accepted for publication, May 18th, 1982)

1,5-Anhydro-D-glucitol (polygalitol) and 1,5-anhydro-D-mannitol (styractitol) are members of the rare class of naturally occurring 1,5-anhydro-alditols[1]. Both compounds are commercially available, but very expensive. 1,5-Anhydro-D-glucitol has been synthesised[2] by reduction of tetra-*O*-acetyl-α-D-glucopyranosyl bromide (**1**) with lithium aluminium hydride, by desulphuration[3] of various, substituted tetra-*O*-acetyl-1-thio-β-D-glucose derivatives with Raney nickel, and by catalytic reduction of **1** over Pd or Pt in the presence of amine bases[4,5]. Similar methods have been used to prepare 1,5-anhydro-D-mannitol[6]. The first two methods are inconvenient and not amenable to large-scale work. The catalytic reduction was found to be capricious and gave widely varying yields, especially on a larger (*i.e.*, 20 g) scale.



1 X = Br
2 X = Cl



3

Recently, Augé and David[7] reported the synthesis of 2,3,4,6-tetra-*O*-acetyl-1,5-anhydro-D-glucitol (**3**) in 86% yield by a thermally initiated reduction of 2,3,4,6-tetra-*O*-acetyl-α-D-glucopyranosyl chloride (**2**) with tributylstannane[8]. Although the scale of this reaction was limited by the need for chromatographic isolation of the product, the reaction was clean and efficient. We now report a modified procedure, which makes **3** and other 1,5-anhydrohexitol derivatives accessible on a substantial scale.

The modified procedure involves (*a*) the bromide **1** rather than the chloride **2**, because it is more easily prepared[9] and more reactive; (*b*) photochemical initiation

---

*To whom correspondence should be addressed.

of the reaction, thereby avoiding the thermal instability of **1**; and (*c*) conversion of the tributyltin bromide formed in the reaction into the highly insoluble tributyltin fluoride by brief treatment with aqueous potassium fluoride and removal by filtration[10]. This procedure, when used on a 100-g scale, gave 86% of **3** after recrystallisation. Similar reduction of tetra-*O*-acetyl-α-D-mannopyranosyl and -α-D-galactopyranosyl bromides gave the corresponding 1,5-anhydrohexitol tetra-acetates in yields of 72 and 70%, respectively.

EXPERIMENTAL

General. — All melting points were determined on a Kofler hot-stage and are uncorrected. Optical rotations were determined with a Thorn TBL 143 polarimeter for solutions in $CHCl_3$. Reagent grade ether was used without further purification.

*2,3,4,6-Tetra-*O*-acetyl-1,5-anhydro-*D*-glucitol* (**3**). — To a magnetically stirred solution of 2,3,4,6-tetra-*O*-acetyl-α-D-glucopyranosyl bromide[11] (**1**; 98 g, 0.238 mol) in ether (400 mL) was added *freshly* distilled Bu_3SnH (70 g, 0.241 mol). The mixture was stirred under a static atmosphere of nitrogen and monitored by t.l.c. (Kieselgel 60; ethyl acetate–light petroleum, 1:1). When **1** had been consumed (~2.5 h), a solution of $KF \cdot 2\ H_2O$ (32 g) in water (125 mL) was added and the mixture was stirred rapidly for 15 min. The Bu_3SnF was collected and washed thoroughly with ether. The water was separated from the combined filtrate and washings, and the ether layer was dried ($MgSO_4$) and concentrated *in vacuo*. The residue was recrystallised from ether–light petroleum, to give **3** (68 g, 86%) as white needles, m.p. 71–73°, $[\alpha]_D^{18}$ +42° (*c* 1.4); lit.[7] m.p. 71–73°, $[\alpha]_D^{20}$ +42.7° (*c* 1.4).

*2,3,4,6-Tetra-*O*-acetyl-1,5-anhydro-*D*-mannitol.* — 2,3,4,6-Tetra-*O*-acetyl-D-mannopyranosyl bromide[6] (4.32 g, 10.5 mmol) was reduced, as described above, with Bu_3SnH (3.12 g, 10.7 mmol) in ether (20 mL). The title product (2.53 g, 7.6 mmol; 66% from α-D-mannose penta-acetate) crystallised from ether–light petroleum as dense prisms, m.p. 63–65°, $[\alpha]_D^{17}$ −41° (*c* 1); lit.[12] m.p. 66–67°, $[\alpha]_D$ −42.4° (*c* 0.8).

*2,3,4,6-Tetra-*O*-acetyl-1,5-anhydro-*D*-galactitol.* — 2,3,4,6-Tetra-*O*-acetyl-D-galactopyranosyl bromide[6] (4.90 g, 11.9 mmol) was reduced with Bu_3SnH (3.50 g, 12.0 mmol) in ether (20 mL) as described above. The title product (2.76 g, 8.35 mmol; 65% from β-D-galactose penta-acetate) crystallised as dense prisms from ether–light petroleum and had m.p. 75–77° (resolidification and m.p. 105–106°), $[\alpha]_D^{17}$ +49° (*c* 1); lit.[3] m.p. 75–76°, $[\alpha]_D$ +49.1°; lit.[14] m.p. 103–105°.

ACKNOWLEDGMENT

We thank the SERC for financial support.

REFERENCES

1 S. SOLTZBERG, *Adv. Carbohydr. Chem. Biochem.*, 25 (1970) 229–283.

2 R. K. NESS, H. G. FLETCHER, JR., AND C. S. HUDSON, *J. Am. Chem. Soc.*, 72 (1950) 4547–4549.
3 N. K. RICHTMYER, *Methods Carbohydr. Chem.*, 2 (1963) 193–194.
4 G. R. GRAY AND R. BAKER, *J. Org. Chem.*, 32 (1967) 2764–2768.
5 L. ZERVAS AND C. ZIOUDROU, *J. Chem. Soc.*, (1956) 214–215.
6 H. G. FLETCHER, JR., *Methods Carbohydr. Chem.*, 2 (1963) 197–198.
7 J. AUGÉ AND S. DAVID, *Carbohydr. Res.*, 59 (1977) 255–257.
8 K. HAYASHI, J. IYODA AND I. SHIIHARA, *J. Organomet. Chem.*, 10 (1967) 81–94.
9 R. U. LEMIEUX, *Methods Carbohydr. Chem.*, 2 (1963) 223–224.
10 J. E. LEIBNER AND J. JACOBIN, *J. Org. Chem.*, 44 (1979) 449–450.
11 R. U. LEMIEUX, *Methods Carbohydr. Chem.*, 2 (1963) 221–222.
12 H. G. FLETCHER, JR., AND H. W. DIEHL, *J. Am. Chem. Soc.*, 74 (1952) 3175–3176.
13 H. G. FLETCHER, JR., AND C. S. HUDSON, *J. Am. Chem. Soc.*, 71 (1949) 3682–3688.
14 E. J. HEDGLEY AND H. G. FLETCHER, JR., *J. Am. Chem. Soc.*, 85 (1963) 1615–1617.