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Note

Improved preparative methods for *p*-nitrophenyl α-D-mannopyranoside tetraacetate and *p*-nitrophenyl α-L-rhamnopyranoside triacetate

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p-Nitrophenyl glycosides are of importance as substrates in enzyme studies. Reduction of the nitro to an amino group gives glycosides that can be attached to proteins in a variety of ways, affording materials of value in immunology. During work on the synthesis of artificial *Salmonella* antigens[1], we required *p*-nitrophenyl α-D-mannopyranoside and *p*-nitrophenyl α-L-rhamnopyranoside as starting materials. Although these glycosides are well-known and their detailed preparations are described in the literature[2,3], and even though the mannoside is commercially available, their preparations, in our hands, have repeatedly been found cumbersome, generally giving much poorer yields of pure products than those reported.

Although the use of tin(IV) chloride to promote the formation of glucosides from 1,2,3,4,6-penta-*O*-acetyl-β-D-glucopyranose and alcohols or phenols was reported[4] as early as 1953, this reaction has not, to our knowledge, been used to effect practical syntheses of *p*-nitrophenyl α-D-mannopyranoside and α-L-rhamnopyranoside.

In the present work, 1,2,3,4,6-penta-*O*-acetyl-β-D-mannopyranose and 1,2,3,4-tetra-*O*-acetyl-β-L-rhamnopyranose were condensed with *p*-nitrophenol in dichloromethane in the presence of tin(IV) chloride. The yields of α-glycosides obtained by direct crystallisation of the worked-up products were 55 and 53%, respectively. If, instead, the α-glycosides were isolated by chromatography of the crude reaction product, the yields were 75 and 76%, respectively. These yields and the ease of preparation compare favourably with those obtained using published procedures[2,3]. T.l.c. examination of the mother liquors indicated that substantial proportions of the β-glycosides were present.

EXPERIMENTAL

General methods. — Melting points are corrected. Concentrations were performed at reduced pressure and a bath temperature below 40°. Optical rotations were measured at 20–22° with a Perkin–Elmer 141 instrument. T.l.c. was performed

on precoated silica gel F_{254} plates (Merck) with detection by charring with sulfuric acid; preparative separations were performed on Kieselgel (0.040–0.063 mm, Merck) columns with toluene–ethyl acetate (2:1). Dichloromethane was dried by refluxing over phosphorus pentaoxide and then distilling.

p-*Nitrophenyl 2,3,4,6-tetra*-O-*acetyl*-α-D-*mannopyranoside*. — A mixture of 1,2,3,4,6-penta-*O*-acetyl-β-D-mannose[3] (3.9 g, 10 mmol), *p*-nitrophenol (1.4 g, 10 mmol), and tin(IV) chloride (2.4 ml) in dichloromethane (10 ml) was boiled under reflux for 3 h. The solution was diluted with dichloromethane, washed successively with saturated, aqueous sodium hydrogen carbonate and water, dried (K_2CO_3), filtered, and concentrated. The residue was crystallised from methanol to afford the title compound (2.6 g, 55%), m.p. 155–156°. If column chromatography was used, the yield was raised to 3.5 g (75%), m.p. 156–157°, $[\alpha]_D$ +102° (*c* 1.0, chloroform); lit.[2] m.p. 156–157°, $[\alpha]_D$ +103° (chloroform).

p-Nitrophenyl 2,3,4-tri-O-*acetyl*-α-L-*rhamnopyranoside*. — The preparation was carried out on the 10-mmol scale with 1,2,3,4-tetra-*O*-acetyl-β-L-rhamnopyranose as described above, except that a reaction time of 30 min was used. After work-up, the residue was crystallised from propan-2-ol to give the title compound (2.2 g, 53%), m.p. 144–146°. If column chromatography was used, the yield was raised to 3.1 g (76%), m.p. 146–147°, $[\alpha]_D$ −119° (*c* 1.2, chloroform); lit.[2] m.p. 145°, $[\alpha]_D$ −117° (chloroform).

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