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**Preliminary communication**

# Synthesis of 2-*O*-β-D-galactopyranosyl-D-galactose

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2-*O*-β-D-Galactopyranosyl-D-galactose has been neither synthesized chemically nor isolated from natural sources, but we have recently reported the presence of 2-*O*-β-D-galactopyranosyl-D-glucose in hydrolysates of lactose treated with microbial β-D-galactosidases[1] and have detected another disaccharide that gave an orange spot on a paper chromatogram–electrophoretogram with diphenylamine–aniline–phosphoric acid (DAAP) reagent[2]. We have now synthesised 2-*O*-β-D-galactopyranosyl-D-galactose.

To a mixture of methyl 4,6-*O*-benzylidene-α-D-galactopyranoside[4] (**2**, 11.5 g), silver carbonate (11.5 g), and Drierite (30 g) in dry dichloromethane (142 mL) was added, with stirring at room temperature under protection from atmospheric moisture, iodine (3 g) and 2,3,4,6-tetra-*O*-acetyl-α-D-galactopyranosyl bromide[3] (**1**, 20.9 g)[5,6]. After 24 h, the mixture was filtered through activated carbon–Celite 545, and evaporated to a thick syrup (26.9 g) that showed four main spots in t.l.c. (silica gel, 7:3 ethyl acetate–benzene). The syrup (11.8 g) in acetic anhydride (30 mL) was stirred with a solution (30 mL) of 4% (v/v) conc. sulfuric acid in acetic anhydride and kept for 5 h at 25°. The mixture was then poured onto ice–sodium hydrogen carbonate and the product extracted with chloroform to afford a syrup (14.5 g) that was dissolved in dry methanol (150 mL) to which was added 0.2M sodium methoxide (45 mL). After 30 min at room temperature and 18 h at 5°, the suspension was diluted with water and deionized with columns of Amberlite IR-120B ($H^+$) and IR-45 ($OH^-$) resins. The eluate was concentrated to ~150 mL and extracted with chloroform (3 X 50 mL). The chloroform extracts were washed with water and the combined aqueous solutions evaporated. The residue (5.11 g) showed three main spots (papergram, 6:4:3 1-butanol–pyridine–water, four times, ascending); these were D-galactose, a green-gray spot (DAAP reagent, $R_{Gal}$ 0.74 on p.c., $M_{Glc}$ 0.69 on a paper electrophoretogram in pH 9.8 borate[2]), and one orange spot (DAAP reagent, $R_{Gal}$ 0.77 on p.c., $M_{Glc}$ 0.52 on a paper electrophoretogram). The carbohydrates were adsorbed on activated carbon (50 g) and Celite 545 (50 g) was added. The mixture was transferred to a Büchner funnel and washed with water (500 mL) followed by 20% ethanol (1 L). The 20% ethanol fraction (which contained only disaccharides) was evaporated; yield 2.61 g.

The disaccharides, phenylhydrazine hydrochloride (5 g), and sodium acetate (10 g) were dissolved in water (125 mL), heated for 1.5 h at 100°; kept overnight at room temperature and then in a refrigerator. The yellow precipitate was filtered, and an additional precipitate was obtained by reheating the filtrate. The filtrate was evaporated. The residue was dissolved in ethanol (45 mL) and water (25 mL), boiled under reflux with benzaldehyde (10 mL) for 5 h in a boiling-water bath, kept overnight at room temperature and then refrigerated. Benzaldehyde phenylhydrazone was filtered off, and the filtrate was then extracted with ether and deionized by passage through ion-exchange columns. The eluate showed two main spots, D-galactose (decomposition of the disaccharide had probably occurred) and the disaccharide. The eluate was stirred with carbon (16 g) and kept overnight. Celite 545 (16 g) was added and the mixture was transferred to a Büchner funnel and washed with water (430 mL), 5% ethanol (320 mL), and 15% ethanol (320 mL). P.c. showed that the 5 and 15% ethanol fractions contained the disaccharide, and these fractions were combined and evaporated (0.80 g).

The residue (0.69 g) was dissolved in methanol–water and a colorless material slowly precipitated (two crops, 0.17 g). Crystallization from ethanol–water gave 2-*O*-β-D-galactopyranosyl-D-galactose (3), m.p. 192–194° (two crops, 75 mg). Recrystallization from the same solvent gave colorless plates of 3 (43 mg), m.p. 195–196°, $[\alpha]_D^{13}$ +86.4° (extrapolated) → +63° (*c* 1.4, water).

*Anal.* Calc. for $C_{12}H_{22}O_{11} \cdot 0.5H_2O$: C, 41.03; H, 6.60. Found: C, 41.18; H, 6.95.

Compound 3 did not give a formazan with alkaline triphenyltetrazolium chloride[7]. The 25-eV mass spectrum of the per(trimethylsilyl) derivative of 3 showed peaks at *m/e* 668, 578 and 361 characteristic of a (1→2) linked disaccharide[8]. Hydrolysis of 3 with crystalline β-D-galactosidase from *Escherichia coli* (Boehringer Mannheim GmbH) gave galactose only.

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