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Note

Deuterium labelling at C-5 in uronic acids

PER J. GAREGG, BENGT LINDBERG, AND BERTIL SAMUELSSON
Department of Organic Chemistry, Arrhenius Laboratory, University of Stockholm, S-106 91 Stockholm (Sweden)

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Aldonic acids are epimerised at C-2 by treatment in alkaline solution or by heating in pyridine[1]. Glycuronic acids are also epimerised, mainly at C-2, on similar treatment, and give complex mixtures[2]. For their glycosides, however, any reactions in alkaline solution should be governed by the carboxyl group.

On treatment of methyl β-D-glucopyranosiduronic acid with 2M sodium hydroxide at 90°, no formation of the L-*ido* derivative was observed. Methyl α-D-galactopyranosiduronic acid was also recovered unchanged after similar treatment. However, when the reactions were performed in deuterium oxide, complete exchange of H-5 by deuterium was observed. This was evident from the ^{13}C-n.m.r. spectra, in which the signals for C-5 had disappeared. The fact that no epimerisation had occurred therefore reflects the greater stability of the D-*gluco* and D-*galacto* derivatives as compared with the L-*ido* and L-*altro* derivatives. The starting material was the methyl glycuronate. When the reaction was performed at room temperature, saponification, but no incorporation of deuterium, was observed.

Only small differences in energy between methyl β-D-glucofuranosiduronic acid and the corresponding L-*ido* derivative would be expected. When the former derivative was treated with base as noted above, no epimerisation was observed but there was considerable degradation. The reason for this difference in reactivity between the furanoside and the pyranoside is most probably that the substituted O-4 in the former is a much better leaving-group than the unsubstituted HO-4 in the latter, and promotes a β-elimination[3].

The specific labelling of glycosiduronates with deuterium at C-5 may be of interest in connection with biosynthetic studies. The reaction should go to completion and in quantitative yield, provided that O-4 is not substituted, and may be applicable to polysaccharides.

A similar reaction has been observed by Prihar *et al.*[4], who found that >85% of the label at C-5 in tritiated methyl (methyl α-D-glucopyranosid)uronate was lost on reduction with sodium borohydride.

EXPERIMENTAL

Sodium (methyl β-D-[5-^2H]glucopyranosid)uronate. — A solution of methyl (methyl β-D-glucopyranosid)uronate[5] (200 mg) in 2M sodium deuteroxide, prepared from sodium (138 mg) and deuterium oxide (3 ml), was stirred magnetically in a plastic tube at 90° for 72 h, and then diluted with water. The solution was treated with Dowex 50 (H^+) resin, filtered, made basic with ammonium hydroxide, concentrated, passed through a short column of Dowex 50 (Na^+) resin, and concentrated to dryness. The yield of the title compound was 203 mg (93%). ^{13}C-N.m.r. data (external Me_4Si): methyl β-D-glucopyranosiduronic acid[6] [5-^{1}H]: δ 58.5 (OCH_3), 72.3 (C-4), 73.8 (C-2), 75.6 (C-5), 76.5 (C-3), and 104.3 (C-1); [5-^{2}H]: δ 58.5 (OCH_3), 72.4 (C-4), 73.8 (C-2), – (C-5), 76.4 (C-3), and 104.3 (C-1).

Sodium (methyl α-D-[5-^2H]galactopyranosid)uronate. — This compound was prepared analogously, starting from methyl (methyl α-D-galactopyranosid)uronate[7]. ^{13}C-N.m.r. data: methyl α-D-galactopyranosiduronic acid [5-^{1}H]: δ 56.7 (OCH_3); 68.9, 70.2, 71.3, 71.6 (C-2,3,4,5); 100.7 (C-1); and 174.3 (C-6); [5-^{2}H]: δ 56.7 (OCH_3); 68.7, 70.0, 71.1, – (C-2,3,4,5); 100.7 (C-1); and 173.6 (C-6).

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