Synthesis of New Chiral Macrocyclic Polyhydroxy Ethers by Reduction of Cyclodextrins

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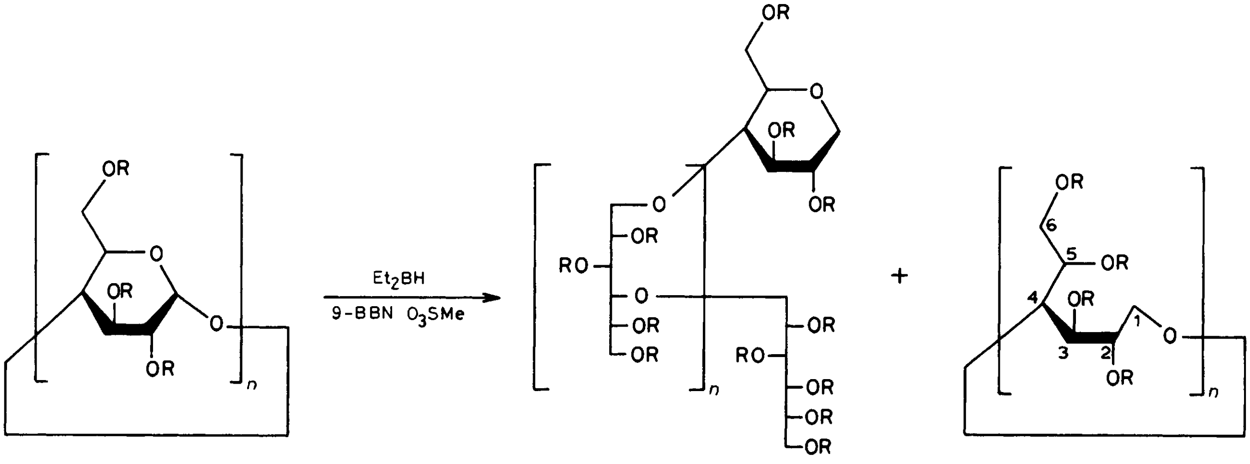
The new chiral macrocyclic polyhydroxy ethers (**5**) and (**8**) were prepared by treatment of β- and α-cyclodextrins with diethylborane and 9-borabicyclo[3.3.1]nonan-9-yl methanesulphonate as catalyst.

In previous papers we have reported[1,2] the reductive cleavage of glycosides and disaccharides with the new reagent system diethylborane–9-borabicyclo[3.3.1]nonan-9-yl methanesulphonate (9-BBN). Three types of cleavage were observed to give cyclic or acyclic alditols. We report now the preparation of new chiral macrocyclic polyhydroxy-ethers by reaction of α- and β-cyclodextrins with this reagent system. Treatment of perborylated β-cyclodextrin (**1**)[3] (0.62 mmol) with excess of



(**1**), $n = 7$, R = BEt_2
(**6**) $n = 6$, R = BEt_2

(**2**), $n = 5$, R = Ac
(**3**), $n = 5$, R = H
(**7**), $n = 4$, R = Ac

(**4**), $n = 7$, R = Ac
(**5**), $n = 7$, R = H
(**8**), $n = 6$, R = Ac

diethylborane at room temperature with subsequent evaporation of triethylboron and then with 9-BBN O_3SMe (0.4 mmol) at 120 °C for 4 h gave a mixture in which no distillable material could be detected. H.p.l.c. analysis of the mixture after deboronation and acetylation indicated the presence of two major products. Separation by column chromatography (silica gel; ethyl acetate–hexane 11:1) yielded compound (**2**), 43%, $[\alpha]_D$ + 72° (*c* 0.12, $CHCl_3$),† and a slower-moving product, 30%, $[\alpha]_D$ + 45° (*c* 0.5, $CHCl_3$), to which structure (**4**) was assigned. The ^{13}C n.m.r. spectrum of (**4**) showed six signals at δ 76.4 (C-4), 69.7 (C-1), 69.5, 69.4, 69.3 (C-2, C-3, C-5), and 61.5 (C-6), indicating a highly symmetrical molecule. The ^1H n.m.r. spectrum at 300 MHz showed signals at δ 4.50 and 4.82 (H-6a, H-6b), 5.59 (H-5), 4.20 (H-4), 4.14 (H-1a, H-1b), and 5.70 (H-2, H-3). Deacetylation of (**4**) (MeOH, MeONa) gave (**5**), $[\alpha]_D$ + 22° (*c* 0.24, H_2O), the ^{13}C n.m.r. spectrum of which showed only six sharp signals at δ 81.5 (C-4), 73.5, 70.4, and 69.9 (C-2, C-3, C-5), 71.4 (C-1), and 62.2 (C-6). Fast atom bombardment mass spectrum showed peaks due to $[M + Na]^+$ at *m/z* 1171 (100%), $[M\,(^{13}C) + Na]^+$ at 1172 (55%), $[M + H]^+$ at 1149 (50%), and $[M + 2Na - H]^+$ at 1193 (20%).

Treatment of the perborylated α-cyclodextrin (**6**)[3] under the above conditions gave a mixture, h.p.l.c. of which, after deboronation and subsequent acetylation, showed the presence of two main products. Separation by column chromatography gave compounds (**7**), (40%), $[\alpha]_D$ + 62° (*c* 0.8, $CHCl_3$), and (**8**), 27%, $[\alpha]_D$ + 36° (*c* 0.5, $CHCl_3$). The ^{13}C and ^1H n.m.r. spectra of these products were similar to those of (**2**) and (**4**), respectively, indicating that reduction took place in the same way as for β-cyclodextrin.

In contrast it has been reported[4] that the reduction of permethylated α-cyclodextrin with triethylsilane in the presence of boron trifluoride–diethyl ether gives mainly a methylated derivative of 1,5-anhydro-D-glucitol, no polyether material being detected in the reaction mixture.

Compounds (**5**) and (**8**) constitute a new type of macrocyclic polyhydroxy ether which may be of interest as potential chiral receptors.

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† The structure of this compound has been determined using 2D n.m.r. spectroscopy; R. Benn, personal communication.

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