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Synthesis of a Novel Sugar Cyclotriveratrylene by Introduction of O-Glycosyl Groups

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SYNTHESIS OF A NOVEL SUGAR CYCLOTRIVERATRYLENE BY INTRODUCTION OF O-GLYCOSYL GROUPS

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Abstract : Introduction of sugar moieties to the periphery of the cyclotriveratrylene skeleton is described.

The preparation of new macrocyclic molecules of well defined cavities is important in the design of synthetic host systems for the encapsulation of guest molecules particularly in aqeous media which have attracted the organic chemists in recent years.[1]

As frequently seen in biological systems the formation of inclusion complexes by hydrophobic interactions in water plays an significant role in the capture and discrimination of organic guests.

Since most of the organic compounds have non-polar moieties, water soluble cyclophanes constitutes a versatile protocol to mimic this aspect, because they

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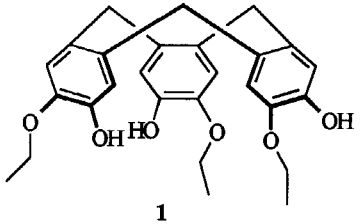
are fully synthetic compounds whose water solubility is provided either by ionic centers[2] or polar neutral residues[3,4] located near to, or remote from the cavity.

There have been few examples of water soluble host compounds bearing a bowl-shaped structure except cyclodextrins. Particularly the water soluble cyclotriveratrylenes are interesting because of their unique molecular architecture composing of well defined structural features which have been exploited as molecular receptors[5,6] towards neutral lipophilic guest molecules in aqueous solution.

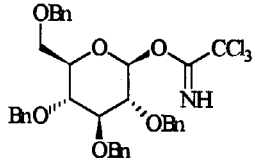
In this paper, we wish to report the first example of a new chiral cyclotriveratrylene by introduction of glycosyl residues to the periphery of the cyclotriveratrylene cavity which would be of great value for the development of a new class of synthetic receptor with the molecular recognition ability.

Initially we attempted the glycosylation of racemic cyclotriphenolene[7] **1** with O-(2,3,4,6-tetra-O-benzyl-α-D-glucopyranosyl) trichloroacet- amidate[8] **2** using TMSOTf or $BF_3{\cdot}OEt_2$ as activator in CH_2Cl_2 at room temperature. But the reaction was unsuccesfull probably due to severe steric interactions between the substrate and the sugar (**Figure-1**).

Figure-1



1

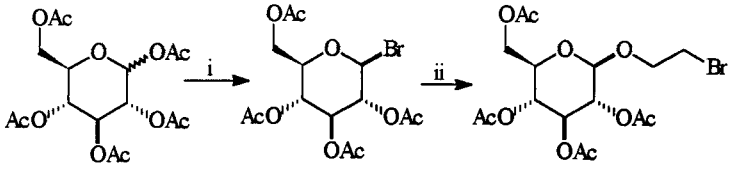


2

Then we envisaged to choose a sugar with a two carbon spacer attached to the anomeric position which would probably minimize the steric

interactions between the donor and the acceptor. For this purpose we have utilised 2-bromoethyl-2,3,4,6-tetra-O-acetyl-ß-D-glucopyranoside[9] **5** as starting ideal precursor which was obtained from penta-O-acetyl-D-glucose **3** following a simple known sequence **(Figure-2)**.

Figure-2

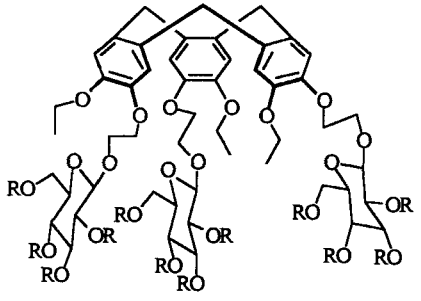


3 **4** **5**

Reagents : i) Ac_2O, $HBr_{(g)}$; ii) 2-Bromoethanol, Ag_2CO_3.

Treatment of bromide **5** (3 eq) with **1** in presence of NaH (3.3 eq) in DMF at 80°C for 26 h furnished a diastereomeric mixtures[10] **6** in 60% yield which on deacetylation with sodium methoxide in methanol afforded the title compound **7** in 93% yield. Attempts to obtain the pure diastereomer were unsuccessful **(Figure-3)**.

Figure-3



6 : R = Ac
7 : R = H

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The quantitative analysis studies showed that sugar **7** was water soluble upto 3.7 x 10^{-3} M at room temperature. Preliminary complexing behaviour of **7** was attempted using 1-anilinonaphthalene-8-sulfonate (ANS)[11] as a guest compound in 25% aqueous methanol. Gradual addition of **7** (0.3 x 10^{-7} M) to ANS solution (0.3 x 10^{-7} M) showed fluorescence quenching of the ANS without causing significant changes in the blue shift of the fluoroscent spectra. This unusual observation of ANS in the presence of the host **7** is not clearly understood, however the results suggest that the host **7** might have not encapsulated ANS into its molecular cavity.

In conclusion we have described the introduction of chiral polyhydroxylated residues to the cyclotriveratrylene frame work which should provide an entry into molecular recognition of suitable guest species in both aqueous and organic media. Currently we are actively pursuing these objectives and the results will be reported elsewhere.

Experimental

Melting points were uncorrected. Optical rotations were measured on JASCO DIP-370 digital polarimeter. ^{1}H NMR spectra were recorded on JEOL FX 9Q FT NMR 200 MHz using TMS as internal standard. Mass spectra were performed on FAB mode using MNBA as the matrix.

2-Bromoethyl 2,3,4,6-tetra-O-acetyl-ß-D-Glucopyranoside (5)

Penta-O-acetyl-D-glucose **3** (6 g) in acetic anhydride (13 ml) was stirred at 0°C. Anhydrous hydrogen bromide gas was constantly bubbled into the solution till complete dissolution of the compound. Excess of solvent was removed under

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vacuo extracted in chloroform washed with water, dried over $CaCl_2$ upon concentration gave the crude ß-D-glucopyronosyl bromide **4** (5.9 g, 93%).

The above bromide **4** (9.2 g, 22.3 mmol), 2-bromoethanol (28 g, 225 mmol) was vigourously stirred at room temperature. To this anhydrous silver carbonate (17 g, 61.8 mmol) was added in portions, efforvescence of CO_2 was observed and the mixture left for 24 h. The mixture was filtered and the filterate distilled to yield the crude which was crystallized from ethanol to yield pure **5** 4 g, 40%, $[\alpha]_D$ = 94.5 (c=3, $CHCl_3$, m.p. 117°C).

^1H NMR : 2.00 (3H, s), 2.05 (3H, s), 2.15 (3H, s), 2.20 (3H, s), 3.80 (4H, m), 4.15 (2H, m), 4.30 (1H, m), 5.01 (3H, m), 5.15 (1H,d).

M.S. : m/z 455.

2,7,12-Triethoxy-3,8,13-tris[2-(2-hydroxyethoxy)-3,5-dimethylcarbonyloxy-6-methylcarbonyloxymethyl tetrahydro-2H-4-pyranylacetyl] 10,15-dihydro-5H-tribenzo[a,d,g]cyclononene, (6)

Sodium hydride (0.12 g, of a 60% (w/w) dispersion in mineral oil 2.9 mmol) was added to a stirred solution of **1** (0.25 g, 0.5 mmol) in DMF (5 ml) under nitrogen atmosphere. The mixture heated at 80°C for 0.5 h and cooled to room temperature. To this, **5** (1.6 g, 3.5 mmol) in dimethylformamide was added and stirred at 100°C. The solvent was removed under *vacuo* and the dark brown residue extracted in dichloromethane (30 ml) washed with water dried over Na_2SO_4 filtered and concentrated the residue, purified over neutral Al_2O_3 eluting with benzene - ethylacetate 7:3 furnished **6** as a colourless solid 1.2 g, 60%, $[\alpha]_D$ = -24° (c=0.93, $CHCl_3$, m.p. 141°C).

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^{1}H NMR $CDCl_3$: δ 1.47 (t, 9H, CH_2CH_3), 1.96-2.12 (4s, 36H, 12 $COCH_3$), 3.52 (d, 3H, $ArCH_2Ar$), 3.72 (m, 6H, $3CH_2O$), 4.02-4.10 (m, br, 12H, $6CH_3CH_2OAr$ & $6CH_2OAr$), 4.19-4.20 (m, 6H, CH_2OAc), 4.22-4.30 (m, 3H, -CH-O), 4.62-4.70 (d, 3H, $ArCH_2Ar$), 4.73-4.80 (m, 3H, CH-OAc), 4.90-5.10 (m, 6H, -CHOAc), 5.12-5.18 (d, 3H, O-CH-O), 6.81-6.83 (2s, 6H, ArH); MS (FAB) : $[M + H]^+$ 1572.

2,7,12-Triethoxy-2,8,13-tris[2-(2-hydroxyethoxy)-6-hydroxy methyl tetrahydro-2H-3,4,5-pyrantriol]10,15-dihydro-5H-tribenzo[a,d,g] cyclononene, (7)

Compound **6** (0.05 g, 0.03 mmol) was dissolved in methanol (0.2 ml). To this sodium methoxide in methanol (0.1N, 0.3 ml) was added and stirred at room temperature for 1 h. Then it was quenched with amberlyst H^+ resin. Solvent filtered and concentrated under *vacuo* to furnish a semisolid 0.03 g, 93%, $[\alpha]_D$ = -6.4 (c=2.5, CH_3OH).

^{1}H NMR $CDCl_3$: δ 1.40 (t, 9H, CH_2CH_3), 3.10 (m, 6H, CH_2OH), 3.50 (d, 3H, $ArCH_2Ar$), 3.70-3.81 (m, 6H, $-OCH_2CH_2$), 4.01-4.15 (m, 12H, 6H, CH_3CH_2-OAr & 6H, CH_2CH_2OAr), 4.18-4.30 (m, 9H, -CHOH), 4.32-4.40 (m, 3H, CH-O), 4.61 (d, 3H, $ArCH_2Ar$), 4.91-4.95 (d, 3H, -O-CH-O), 7.01-7.11 (2s, 6H, ArH); MS (FAB) : $[M + H]^+$ 1068.

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References :

1. Lehn, J.M. *Science*. **1985**, *227*, 849.
2. Goto, K.; Akine, S.; Hayashi, T.; Okazaki, R. *Chem. Lett.*, **1998**, 291.
3. Coterón, M.J.; Vicent, C.; Bosso, C.; Penadés, S. *J. Am. Chem. Soc.*, **1993**, *115*, 10066.
4. Marra, A.; Scherrmann, M.C.; Casnati, A.; Minari, P.; Ungaro, R. *Angew. Chem. Int. Ed. Engl.*, **1994**, *33*, 2479.
5. Menger, F.M; Takeshita, M.; Chow, J.F. *J. Am. Chem. Soc.*, **1981**, *103*, 5938.
6. Collet, A.; Dutasta, J.P.; Lozach, B.; Canceill, J.; Weill, J. *Demande de Brevet Francais*, **1990**, *90*, 10614.
7. Canceill, J.; Collet, A.; Gabard, J.; Gottarelli, J.; Spada, G.P. *J. Am. Chem. Soc.*, **1985**, *107*, 1299.
8. Schmidt, R.R.; Stumpp, M. *Liebiegs. Ann. Chem.*, **1983**, 1249.
9. Compund **5** was prepared with a slight modification and characterised by physical data according to the method described by Coles, H.W.; Dodds, M.C.; Bergeim, F.H. *J. Am. Chem. Soc.*, **1936**, *60*, 1020.
10. Collet, A.; Gabard, J.; Jacques, J.; Cesanio, M.; Guilhem, J.; Pascard, C. *J. Chem. Soc. Perkin Trans I.* **1981**, 1630.
11. Tabushi, I.; Sasaki, H.; Kuroda, Y. *J. Am. Chem. Soc.*, **1976**, *98*, 5727.

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