Tetrahedron Letters No.22, pp. 1391-1394, 1964. Pergamon Press Ltd.
Printed in Great Britain.

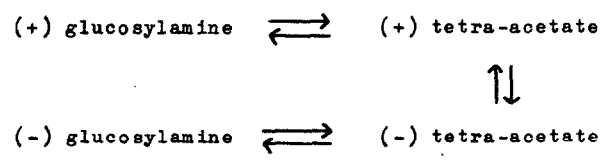
THE STRUCTURE OF SOME N-ARYL GLUCOSYLAMINES

Brian Capon and Brian E. Connett
Chemistry Department, Birkbeck College, Malet Street, London, W.C.1

(Received 9 April 1964)

Pyranose, furanose and acyclic Schiff base structures are possible for the aryl glucosylamines, but until recently only the p-tolyl glucosylamine was known in two forms[1]. Bognár and Nánási[2] have now succeeded in isolating several isomeric pairs and it is clear that some of the aryl glucosylamines previously reported were mixtures[1]. We have now shown by a combination of an acetylation method and nuclear magnetic resonance spectroscopy that the positively rotating p-tolyl [m.p. 140°-141°, $[\alpha]_D$ +239° (MeOH)] and phenyl [m.p. 149°-150°, $[\alpha]_D$ +237 (MeOH)] compounds have the α-pyranose structure and that their negatively rotating isomers [m.p. 112°-113°, $[\alpha]_D$ -102° (MeOH) and m.p. 135°-136°, $[\alpha]_D$ -105° (MeOH) respectively] the β-pyranose structure. Previous attempts to assign structures have failed, those using methylation owing to the poor yields of methylated compounds obtained[3], and those using periodate oxidation because of complete oxidation[4].

Both isomers of N-p-tolyl D-glucosylamine were subjected to the following acetylation-deacetylation cycle:-



The acetylation reactions were carried out with 50% excess of acetic anhydride in pyridine at 0°, and deacetylation in dry methanol, using conditions under which the deacetylated product was precipitated immediately it was formed. Yields for all stages of the cycle were better than 95%. The laevorotatory tetra-acetate could be prepared also by condensation of p-toluidine with acetobromoglucose. As this compound is known to be α-pyranose and to react with inversion of configuration[5], the laevorotatory tetra-acetate must have a β-pyranose structure. This is supported by the N.M.R. spectrum (see below). The dextrorotatory tetra-acetate could be prepared from the kinetically first-order reversible isomerisation of the β-tetra-acetate and is, therefore, almost certainly pyranose. Extensive acetyl migration would have to take place if it were furanose and the reaction would then not be expected to show the simple first-order kinetics. This conclusion is also supported by the N.M.R. spectrum (see below).

Each of the free bases can be subjected to an acetylation-deacetylation cycle with retention of the sign and magnitude of rotation; i.e. independent of the other isomer. If ring expansion or contraction occurred during acetylation or deacetylation it would have to take place quantitatively and be quantitatively reversed in the reverse stage. This is considered to be extremely unlikely. Similar reaction cycles

were carried out for the N-phenyl-D-glucosylamines.

These results, therefore, establish the pyranose ring size for the p-tolyl and phenyl glucosylamines. The configurational assignments were confirmed by the N.M.R. spectra, measured using dry pyridine solutions. The anomeric protons of the dextrorotatory isomers gave signals at 5.54 and 5.48 p.p.m. from TMS with splittings of 4.0 c.p.s. which is of the size to be expected for the α-D-glucopyranose configuration,[6] while those of the laevorotatory isomers gave signals at 5.05 and 5.15 p.p.m. with splittings of 8.0 and 7.5 c.p.s., thus confirming the β-D-glucopyranose configuration.[6]

Analysis of the N.M.R. spectra of the acetylated glucosylamines is more complicated because the signals from the anomeric protons do not appear at lower fields than the signals from the other ring protons. The chemical shifts for all the ring protons are therefore very similar and analysis of the spectra by a simple first-order treatment is not justified. The spectrum of N-p-tolyl-tetra-O-acetyl β-D-[$^2H_1$] glucosylamine lacked two signals centred at 4.87 p.p.m. and 9.0 c.p.s. apart and that of its α-anomer lacked a signal at 5.30 p.p.m., present in the protonated compounds. Although a detailed theoretical analysis of these spectra is not possible, the results support the configurational assignments given, the signal from the β-compound with the axial anomeric proton appearing at higher field than that from the α-compound with an equatorial proton.

The close resemblance of the N.M.R spectra of the negatively rotating p-hydroxyphenyl, p-trifluoromethylphenyl, p-carboxyphenyl and p-nitrophenyl D-glucosylamines to those of the

p-tolyl and phenyl compounds, support β-D-glucopyranose structures, while the α-D-glucopyranose structure is similarily indicated for the positively rotating p-nitrophenyl compound. The o-carboxyphenyl D-glucosylamine of m.p.131°-132° and $[\alpha]_D$ +87.6° is clearly a mixture of the α- and β-forms, since two signals for the anomeric protons at 5.15 and 5.62 p.p.m. are found in the N.M.R. spectrum. All attempts to separate them by fractional crystallisation failed.

We thank Professor W.B.Whalley for placing a Varian A-60 N.M.R. spectrometer at our disposal and Miss J.Lovenack for measuring the spectra. We thank also Professor W.G.Overend for his interest and encouragement.

1 G.P.Ellis and J.Honeyman, Advanc. Carbohyd. Chem., 10 95 (1955).

2 R.Bognár and P.Nánási, J. Chem. Soc., 323 (1961); Mag. Chem. Fóly., 68 32 (1962).

3 Cf. ref.[1], p. 109.

4 G.A.Howard, G.W.Kenner, B.Lythgoe and A.R.Todd, J. Chem. Soc., 861 (1946).

5 See L.J.Haynes and F.H.Newth, Advanc. Carbohyd. Chem., 10 207 (1955).

6 See R.U.Lemieux and D.R.Lineback, Annu. Rev. Biochem., 32 155 (1963).