syn- and *anti*-Pyranosidulose Oxime

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PYRANOSIDULOSE OXIMES have been recently prepared.[1-3] The n.m.r. data presented in one case[1] indicated that only one isomer was present.

This Communication reports that methyl 2,3-*O*-isopropylidene-β-L-*erythro*-pentopyranosidulose oxime prepared earlier[2] is a mixture of *syn*- and *anti*-isomers and assigns structures (I) and (II) to them respectively.[4] N.m.r. analysis of the mixture shows it to be composed of 66% of one isomer and 34% of the other.[5] Examination of isomers separated chromatographically[6] showed this analysis of the spectrum to be correct. The more mobile isomer was the major component. The chemical shifts for the protons relevant to this discussion are tabulated. The other signals in the spectrum were easily identified, and they integrated correctly.

N.m.r. studies have recently been used to assign structures to *syn*- and *anti*-oximes.[7,8] In particular it has been shown[7] that aldoximes of the type $R_2CH{\cdot}CNOH{\cdot}H$ show a low-field α-methine proton when the oxime hydroxyl is *cis* to it. This has been explained by the preferred rotomer being the preferred conformation would be that in which the hydrogen, rather than the more bulky methoxyl group was in the C=N–OH plane [see (I)]. The other isomer has the H_3 doublet at a low field, lower even than the anomeric proton. This isomer would be expected to have the oxime hydroxyl group *cis* to C-3. The preferred conformation being the one with the H_3 in the plane of the C=N–OH as depicted in (IIa).

With oximes containing alkoxy-groups the possibility of the conformation being determined by intramolecular hydrogen bonding should be one in which the α-methine proton is situated in the plane of the C=N–OH.

Examination of the C-2 region of a Dreiding molecular model of the pyranosidulose oxime, shows that in conformation (I) or (IIa) the equatorial substituents on C-1 and C-3 are nearly eclipsed by the C=N. Therefore the isomer which exhibits a low-field signal for H_1 would be expected to have the oxime hydroxyl *cis* to the C-1, and the

TABLE

Chemical Shifts in c./sec. †

	H_1		H_3	
	Perdeuterodimethyl sulphoxide	Pyridine	Perdeuterodimethyl sulphoxide	Pyridine
syn-(I) (R=H)	337	369	293 (7·0)	314 (7·1)
anti-(II) (R=H)	312	337	325 (7·7)	357 (7·7)
syn-(I) (R=Ac)	340	348	297 (6·4)	304 (6·5)
anti-(II) (R=Ac)	313	322	313 (6·6)	319 (6·5)

† 60 Mc./sec. on Varian A 60, using Me_4Si as internal standard. Measured splitting for H_3 doublet are in parenthesis.

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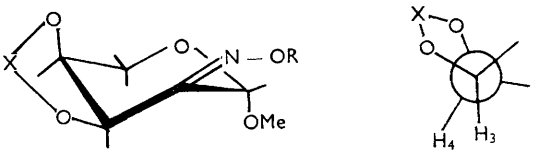
considered.[9] However in conformations (I) and (II) intramolecular hydrogen bonding should not be strongly favoured.[10] The following two observations show intramolecular hydrogen bonding to be unimportant in these oximes. Firstly i.r. studies showed that the molar integrated absorption intensity for the bonded hydroxyl decreased linearly on dilution and extrapolated through the origin at zero concentration.[11] Secondly, acetylation of the isomeric mixture gave a product which had the same isomer distribution. The chemical shifts for H_1 and H_3 are recorded. In the *syn*-isomer (I, R=Ac) the H_1 proton is still at low field [$\Delta_{syn-anti}$ $H_1 = 27$ (I, R=Ac); *cf.* 25 for (I, R=H)][12] and in the *anti*-isomer (II, R=Ac) H_3 is again at low field, although not lower than the anomeric proton on this occasion [$\Delta_{syn-anti}$ $H_3 = 16$ (II, R=Ac) *cf.* 32 for (II, R=OH)].[12] Therefore the chemical shifts of H_1 and H_2 behave similarly in these isomers whether intramolecular hydrogen bonding can occur or not.

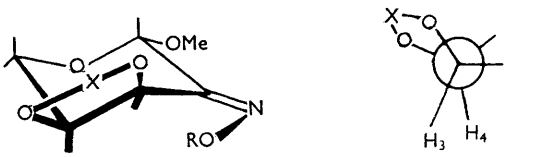
The coupling between H_3 and H_4 is similar for each isomer (see Table). This suggests that the *anti*-isomer is in the chair conformation (IIa), because this has a dihedral angle between H_3 and H_4 of about 30° which is the same as that for the *syn*-isomer in the chair conformation (I).

A boat conformation for the *anti*-isomer (IIb) is shown by Dreiding models to be a possibility, which meets the requirements of the H_3 and C=N being almost in the same plane. However this conformation can probably be excluded, particularly in the acetylated case, because the dihedral angle between H_3 and H_4 is less than 10° and this should exhibit a larger $J_{3,4}$ coupling constant.

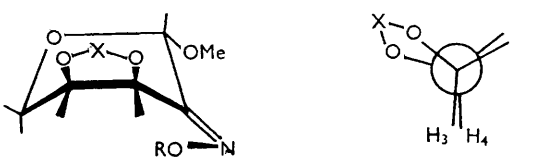
A solvent effect has been observed. On changing from perdeuterodimethyl sulphoxide to pyridine there is a downfield shift for both H_1 and H_3 protons, but the effect is larger for that proton which is claimed to be *cis* to the oxime hydroxyl. However, with the acetylated oxime this is greatly diminished and is the same for both protons. Thus hydrogen bonding to the pyridine appears to be important.



(I)



(IIa)



(IIb)

X = >CMe$_2$

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[2] P. M. Collins and W. G. Overend, *J. Chem. Soc.*, 1965, 3448.
[3] B. Lindberg and O. Theander, *Acta Chem. Scand.*, 1959, **13**, 1226; J. S. Brimacombe and M. C. Cook, *J. Chem. Soc.*, 1964, 3448.
[4] In this text the isomer in which the hydroxyl is *cis* to the lowest-numbered ring carbon has been named *syn*.
[5] Average of seven preparations ± 3%.
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[9] M. Tichý, *Adv. Org. Chem.*, 1965, **5**, 115.
[10] The oxygen–oxygen distance is just greater that 3·4Å.[9] There are other conformations however which would favour intramolecular hydrogen bonding.
[11] Concentration range 13·5 to 1·0 × 10^{-3} moles $l.^{-1}$. It is disturbing that a very low intensity bonded-hydroxyl signal persisted at 5·0 × 10^{-4} moles $l.^{-1}$ but this is probably residual intermolecular bonding.
[12] $\Delta_{syn-anti}$ = Difference in chemical shift (c./sec.) for the proton indicated in the *syn*-(I) and *anti*-(II) isomers, measured in perdeuterodimethyl sulphoxide.