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N.M.R. EVIDENCE FOR THE ACYCLIC STRUCTURE OF SOME SUGAR PHENYLHYDRAZONES: A CONFIRMATION OF THE FORMAZAN TEST.

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Two methods rendered good service in the elucidation of the acyclic aldehydo-structure of some sugar phenylhydrazones: the acetylation method (1,2) and the formazan reaction (3,4,5). The results obtained by these methods were confirmed by u.v. spectral data (6) and also by polarographic investigations (7).

Recently Blair and Roberts (8) called in question the usefulness of both methods in view of their investigations, especially of the p-bromophenylhydrazone of L-arabinose, by infrared spectroscopy. The i.r. data confirmed the cyclic structure of this compound in solid state, proposed earlier on the basis of X-ray studies (9). However, they also found a positive formazan test for this compound, indicating the presence of the acyclic aldehydo-structure. Because of this apparent contradiction Blair and Roberts rejected the evidence furnished by the formazan method.

The following remarks can be made about the data of the above authors:

i) For elucidating of the structure of sugar phenylhydrazones (3) formazans must be formed at -5°C (not at +5°C).

ii) Pure L-arabinose p-bromophenylhydrazone is not soluble at room temperature in pyridine-ethanol (1:1) in the concentration used by Blair and Roberts. Thus the compound had to be impure, or dissolved by heating. In either event the reported results are of uncertain diagnostic value.

iii) The yield of formazan was not mentioned. Since the presence of a few per cent of acyclic form alongside the cyclic compound also gives a positive formazan test, the product yield is important.

iv) Thus far, the formazan reaction has been used only for the elucidation of the structure of sugar phenyl- and tolyl-hydrazones (3,10). Some phenyl substituents could change the rate of conversion of the hydrazone forms in the presence of a basic solvent like pyridine.

In fact, we have found a rapid transition of the initial cyclic hydrazone structure into the acyclic form through the formazan reaction of L-arabinose p-bromophenylhydrazone in pyridine-ethanol (1:1) solution (c 1.66) (see Figure 1). Tracing the curve of the formazan formation makes following this rapid structural change facile. N.m.r. analysis confirms these results.

L-ARABINOSE p-BROMOPHENYL HYDRAZONE IN PYRIDINE-ETHANOL (1:1)

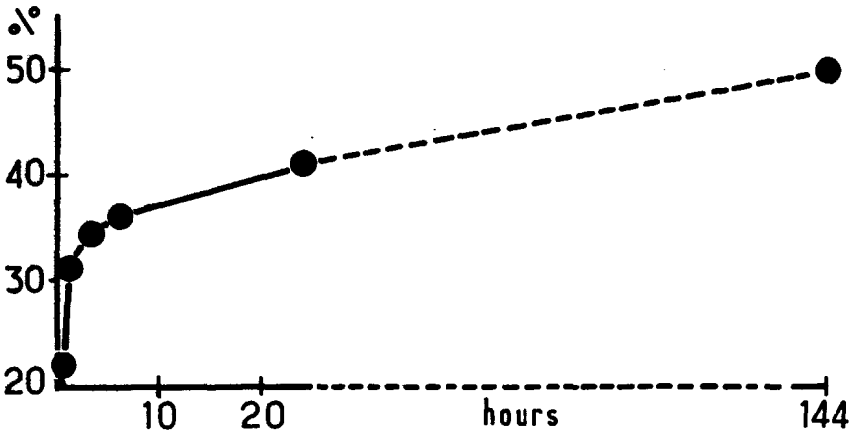

Fig.1. Yield of formazan

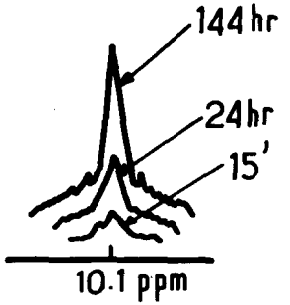

Fig.2. N-H signal (N.m.r)

Wolfrom and coworkers (11) first reported that the presence of a low field signal in deuteriochloroform solution due to the formyl proton on C-1 is indicative of an acyclic structure in sugar phenylhydrazones. However, in some cases this signal is buried in the aromatic multiplet and in such a case the presence of an acyclic structure must be determined in another way.

We have found now that the n.m.r. spectra of acyclic sugar phenylhydrazones in deuteriopyridine possess a sharp N-H signal distinctly displaced to low field by the presence of the vicinal carbon-hydrogen double bond. It is located e.g. at 10.9 ppm in the spectrum (deuteriopyridine, 60 Hz, TMS) of the penta-O-acetyl-aldehydo-D-galactose phenylhydrazone (12) and disappears by exchange with deuterium oxide.

In the n.m.r. spectrum of L-arabinose p-bromophenylhydrazone in deuteriopyridine-ethanol (1:1) solution this signal soon appears at 10.1 ppm and increases with time (see Figure 2), paralleling the increasing yield of formazan. Consequently, the formazan method appears to be applicable even to cases of substituted phenylhydrazones of sugars.

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R e f e r e n c e s .

1. R. Behrend and W. Reinsberg, Annalen, 377, 180 (1910).
2. M.L. Wolfrom and C.C. Christman, J.Amer. Chem. Soc., 53, 3413 (1931).
3. L. Mester and A. Major, J. Amer. Chem. Soc., 77, 4297 (1955).
4. L. Mester, Adv. Carbohydrate Chem., 13, 105 (1958).
5. L. Mester and A. Messmer, Meth. Carbohydrate Chem., 2, 119 (1963).
6. J. O'Donnell and E.E. Percival, J. Chem. Soc., 2312 (1959).
7. J.W. Haas, Jr., J.D. Strorey and CC. Lynch, Analyt. Chem., 34, 145 (1962).
8. H.S. Blair and G.A. Roberts, J. Chem. Soc., 2425, (1967).
9. S. Furberg and C.S. Petersen, Acta Chem. Scand., 16, 1539 (1962).
10. H.-H. Stroh and B. Ihlo, Chem. Ber., 96, 658 (1963).
11. M.L. Wolfrom, G. Fraenkel, D.R. Lineback and F. Komitsky, Jr., J. Org. Chem., 29, 457.
12. L. Mester and A. Messmer, Meth. Carbohydrate Chem., 2, 118 (1963).