259. *Studies on Osazones:* d- *and* l-*Dianhydrohexosazone.*

By E. G. V. Percival.

Evidence is presented that the dianhydrohexosazone obtained on deacetylating glucosazone and galactosazone tetra-acetates contains no free primary alcoholic residue, and the presence of the ketopyranose ring previously postulated is therefore supported.

d-Gulosazone tetra-acetate is shown to yield the same dianhydrohexosazone, from which it is concluded that Walden inversion can take place either on C_3 or on C_4, and that anhydride formation must have occurred at these points, otherwise the same product could not be obtained from the three stereochemically different arrangements.

The corresponding *l*-dianhydrohexosazone has been prepared from *l*-sorbosazone tetra-acetate.

The formula for glucosazone advanced by Percival and Percival (J., 1935, 1398) involving a fructopyranose ring has recently received support by the observation of Diels, Cluss, Stephan, and König (*Ber.*, 1938, **71**, 1189) that neither glucosazone nor dehydroglucosazone could be made to react with triphenylchloromethane, a fact which is taken as evidence of the absence of a free primary alcoholic residue.

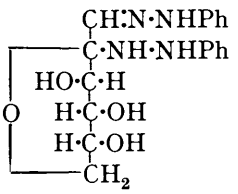
The present series of experiments on dianhydro-osazones derived from *d*-gulose and *l*-sorbose lends further support to this view, as well as to the structure advanced for the dianhydro-osazone isolated from both *d*-glucosazone and *d*-galactosazone by the deacetylation of their tetra-acetates (Percival, J., 1936, 1770).

This dianhydrohexosazone was allowed to react with *p*-toluenesulphonyl chloride, and the crystalline p-*toluenesulphonyl dianhydrohexosazone* treated with sodium iodide in acetone at 100° for 25 hours. The original *p*-toluenesulphonate was recovered unchanged in almost quantitative yield, and even on prolonging the treatment for 100 hours no replacement of the *p*-toluenesulphonyl residue by iodine could be detected. This replacement reaction used under much less stringent conditions has been employed as a test for the presence of primary alcoholic residues by many workers (Oldham and Rutherford, *J. Amer. Chem. Soc.*, 1932, **54**, 366; Bell, J., 1934, 1177; Bell and Synge, J., 1937, 1711), and since there is no reason to apprehend anomalous behaviour in this case, the $-CH_2 \cdot OH$ residue must be regarded as absent.

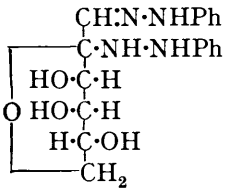
Conclusive evidence that the anhydride formation is concerned with the hydroxyl groups on C_3 and C_4 was secured by the observation that d-*gulosephenylosazone tetra-acetate* yielded on deacetylation the same dianhydrohexosazone as that isolated previously

from *d*-glucosazone and *d*-galactosazone, identity being proved by analysis and physical constants, as well as by mixed m. p. determinations of both the anhydride and its monoacetate.

In the previous paper (*loc. cit.*) it was pointed out that, since glucosazone and galactosazone gave rise to the same dianhydrohexosazone, a Walden inversion must have taken place on C_4 in one case. It is now clear that this inversion can take place on either C_3 or C_4 or on both in order to arrive at the most stable arrangement of the three rings. This can readily be seen by reference to the stereochemical formulæ for the three osazones, and it is apparent that, if anhydride formation were concerned with any other hydroxyl group or potential hydroxyl group, identical products would not be obtained from the three different sources.



d-Glucosazone.



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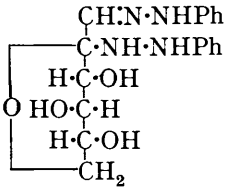
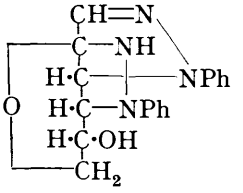


d-Gulosazone.



d-Dianhydrohexosazone.

It seems probable that *d*-allosazone would give rise to the same *d*-hexosazone anhydride. From the evidence at present available it cannot be decided whether the anhydride is a derivative of *d*-fructo-, *d*-tagato-, *d*-sorbo-, or *d*-psico-pyranose.

Tetra-acetyl l-*sorbosazone* on deacetylation yielded the l-*enantiomorph* of the *d*-hexosazone anhydride in harmony with the above observations.

Experimental.

d-*Dianhydrohexosazone* p-*Toluenesulphonate.*—*d*-Dianhydrohexosazone (2 g.), prepared from tetra-acetyl galactosazone as previously described (*loc. cit.*), was treated with *p*-toluenesulphonyl chloride (2 g.) in pyridine (5 c.c.) for 40 hours, and the mixture poured into water; after being washed, the product (2·5 g.) was recrystallised from ethyl alcohol, yielding pale yellow needles, m. p. 205—206°, $[\alpha]_D^{20°}$ + 38° in acetone (*c*, 0·4) (Found: C, 62·9; H, 4·9; N, 11·6. $C_{25}H_{24}O_4N_4S$ requires C, 63·0; H, 5·1; N, 11·8%).

Treatment with sodium iodide. The above product (1 g.), together with sodium iodide (1·5 g.) and acetone (7·5 c.c.), was heated in a sealed tube at 100° for 25 hours. After cooling, the acetone was removed, the product washed with dilute sodium thiosulphate solution and water, and recrystallised from alcohol. 0·95 G. of the original substance, m. p. 205°, was obtained and no iodine could be detected in this product or in any of the residues obtained on evaporation of the mother-liquors. On repeating the experiment for 100 hours the yield of pure recovered material was less owing to charring but no iodine could be detected in any of the fractions.

Preparation of d-*Gulosazone.*—*d*-Xylose (30 g.) was converted into *d*-gulonolactone (20 g.) by the method of Hudson, Hartley, and Purves (*J. Amer. Chem. Soc.*, 1934, **56**, 1248). The product had m. p. 186°, $[\alpha]_D^{20°}$ − 56° in water (*c*, 0·8). This was converted into a crude gulose syrup (7 g.) by reduction with sodium amalgam after the method of Fischer and Stahel (*Ber.*, 1891, **24**, 528) as modified by Isbell (*Bur. Stand. J. Res.*, 1930, **5**, 741). The gulose syrup so obtained showed $[\alpha]_D^{14°}$ − 17° in water (*c*, 0·4), and was treated with phenylhydrazine hydrochloride (14 g.), crystalline sodium acetate (21 g.), and a trace of sodium bisulphite at 95—100° for 3 hours. After cooling and filtration from precipitated osazone, the mother-liquors were again heated for 4 hours. Yield 4 g., m. p. 160°, $[\alpha]_D^{15°}$ + 12° in pyridine–alcohol (4 : 6) (*c*, 0·5).

Tetra-acetyl d-*Gulosazone.*—*d*-Gulosazone (3 g.) was treated for 16 hours at room temperature with acetic anhydride (6 c.c.) and pyridine (16 c.c.). The product was poured into water and washed, but could not be crystallised. Yield quantitative, m. p. 75—85°, $[\alpha]_D^{15°}$ + 70° in chloroform (*c*, 0·4) (Found: C, 59·5; H, 5·9; CH_3·CO, 31·9; N, 10·8. $C_{26}H_{30}O_8N_4$ requires C, 59·3; H, 5·9; CH_3·CO, 32·7; N, 10·6%).

Deacetylation. This was carried out on the above substance (6 g.) as previously described for tetra-acetyl glucosazone with sodium hydroxide in aqueous acetone (Percival, *loc. cit.*) to yield a product (1·1 g.) indistinguishable from the dianhydrohexosazone previously described. It showed m. p. 238°, unchanged on admixture with the original anhydride, $[\alpha]_D^{15°}$ − 89° in

acetone (*c*, 0·3) (Found : C, 67·0; H, 5·8; N, 17·6. Calc. for $C_{18}H_{18}O_2N_4$: C, 67·1; H, 5·6; N, 17·4%).

Isolation of the monoacetyl derivative. Acetylation as before with acetic anhydride and pyridine yielded a product of m. p. 135° alone or mixed with a specimen prepared from the dianhydrohexosazone previously described, $[\alpha]_D^{15°}$ + 108° in chloroform (*c*, 0·3) (Found : C, 65·7; H, 5·4; CH_3·CO, 11·8; N, 15·7. Calc. for $C_{20}H_{20}O_3N_4$: C, 65·9; H, 5·5; CH_3·CO, 11·8; N, 15·4%).

Tetra-acetyl l-*Sorbosazone.*—*l*-Sorbosazone, m. p. 160—164°, $[\alpha]_D^{15°}$ − 13° in pyridine–alcohol (4 : 6) (*c*, 0·7) was acetylated as described for *d*-gulosazone. The yellow amorphous powder isolated had m. p. 75—85°, $[\alpha]_D^{15°}$ − 70° in chloroform (*c*, 0·3), yield quantitative (Found : C, 59·1; H, 6·2; CH_3·CO, 32·0; N, 10·9. $C_{26}H_{30}O_8N_4$ requires C, 59·3; H, 5·9; CH_3·CO, 32·7; N, 10·6%).

Isolation of l-*Dianhydrohexosazone.*—Deacetylation of the above product (2·5 g.) gave a *compound* (0·4 g.) identical in appearance with that obtained from osazones of the *d*-series, m. p. 237°, mixed m. p. with *d*-dianhydrohexosazone 200°, $[\alpha]_D^{15°}$ + 89° in acetone (*c*, 0·5) (Found : C, 67·3; H, 5·7; N, 17·6. $C_{18}H_{18}O_2N_4$ requires C, 67·1; H, 5·6; N, 17·4%).

l-*Dianhydrohexosazone Monoacetate.*—Prepared in the usual way, this *compound* had m. p. 135°, mixed m. p. with *d*-dianhydrohexosazone monoacetate, 105—108°, $[\alpha]_D^{17°}$ − 107° in chloroform (*c*, 0·5) (Found : C, 65·9; H, 5·8; CH_3·CO, 11·9; N, 15·5. $C_{20}H_{20}O_3N_4$ requires C, 65·9; H, 5·5; CH_3·CO, 11·8; N, 15·4%).

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