37. *Action of Pyridine–Acetic Anhydride on Aldose Oximes. Production of Hexa-acetyl Aldomannoseoxime.*

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SINCE pyridine–acetic anhydride converts glucoseoxime mainly into a hexa-acetylated oxime at a low temperature and into penta-acetyl glucononitrile at a high temperature (Behrend, *Annalen*, 1907, **353**, 109), whereas from xylose- and arabinose-oxime the corresponding acetylated nitriles are produced even at a low temperature (Mendive, *Chemia*, 1930, **7**, 321; Deulofeu, J., 1932, 2973), the action of the reagent on various aldose oximes has been studied.

The first result obtained was the demonstration (Deulofeu, Wolfrom, and others, *J. Amer. Chem. Soc.*, 1933, **55**, 3488) that galactoseoxime yields a mixture of penta-acetyl galactononitrile and two isomeric hexa-acetyl oximes, one being the open-chain form and the other derived from the semi-acetalic form. The results obtained with other oximes will now be described.

Arabinose-, Xylose-, and Rhamnose-oximes.—The only products obtained, even at 0° and with low concentrations of acetic anhydride, are the acetylated nitriles: evidently each oxime reacts in the open-chain form which Wolfrom and Thompson (*J. Amer. Chem. Soc.*, 1931, **53**, 622) have shown to be an intermediate in the formation of the nitrile. The acetylated open-chain oximes must be very unstable compounds, easily losing acetic acid and producing the nitriles. This supposition is supported by the fact that tetra-acetyl aldoarabinoseoxime could not be further acetylated, even under mild conditions, the nitrile being always obtained (Deulofeu, Wolfrom, and others, *loc. cit.*).

Glucose- and Mannose-oximes.—In these reactions, the products obtained depend on the temperature and on the concentration of acetic anhydride: the acetylated oxime, the nitrile, or both compounds may be produced. There is, however, an important difference between the two reactions. The hexa-acetyl glucoseoxime isolated is the same as that obtained by Behrend (*loc. cit.*), that is, it has a semi-acetalic structure and is not the unstable open-chain intermediate form in the nitrile formation (Wolfrom and Thompson, *loc. cit.*). The *hexa-acetyl mannoseoxime* obtained can, on the contrary, be transformed above its melting point into penta-acetyl mannononitrile, and therefore must be considered an aldo-form by analogy with the results obtained with glucose and galactose (*loc. cit.*).

Mannoseoxime behaves similarly to galactoseoxime. This tendency to react as an open-chain true aldehydo-oxime explains why the acetylated mannononitrile is produced at a lower temperature than glucononitrile. The hexa-acetyl mannoseoxime is not transformed into penta-acetyl mannononitrile under conditions which produce the latter from the free oxime.

The rotatory power of tetra-acetyl *l*-rhamnononitrile, $[\alpha]_D^{20^\circ}$ $-4{\cdot}0^\circ$, is the first exception to a rule, which we hoped would establish the direction of the rotation of acetylated aldonitriles (*Nature*, 1933, **131**, 548).

EXPERIMENTAL.

The preparation of hexa-acetyl mannoseoxime is described in detail. For the other preparations, carried out in the same way, only the time and the temperature are given. The yields recorded are the sum of the partial yields obtained from different fractions. The crystalline products were identified in most cases by mixed m. p. determinations with authentic specimens. Rotations were measured in chloroform solution.

Reagent I denotes a mixture of 6·3 c.c. of pyridine and 4·2 c.c. of acetic anhydride for the quantity of oxime indicated. Reagent II denotes 2 c.c. of pyridine and 5 c.c. of acetic anhydride.

Pentose Oximes (0·85 g. of oxime; 8 days at 0°).—Arabinoseoxime gave tetra-acetyl arabononitrile (0·85 g., m. p. 119°, $[\alpha]_D^{20^\circ}$ $+4{\cdot}2^\circ$, with reagent I, and 0·90 g., m. p. 118°, $[\alpha]_D^{20^\circ}$ $+4{\cdot}1^\circ$, with reagent II). Xyloseoxime gave tetra-acetyl xylononitrile (0·22 g., m. p. 83°, $[\alpha]_D^{20^\circ}$ $+50{\cdot}3^\circ$, with reagent I, and 0·09 g., m. p. 83°, $[\alpha]_D^{20^\circ}$ $+50{\cdot}4^\circ$, with reagent II).

Rhamnoseoxime (0·9 g.; 8 days at 0°) gave tetra-acetyl rhamnononitrile (0·35 g., m. p. 70°, $[\alpha]_D^{20^\circ}$ $-4{\cdot}0^\circ$, with reagent I, and 0·36 g., m. p. 71°, $[\alpha]_D^{20^\circ}$ $-3{\cdot}9^\circ$, with reagent II). Alterations of temperature and of time did not change the nature of the products; they were always the acetylated nitriles.

Hexose Oximes (1 g. of oxime).—With reagent I, glucoseoxime gave : after 8 days at 0°, 0·9 g. of pure hexa-acetylated oxime, m. p. 113—115°, $[\alpha]_D^{20^\circ}$ + 7·2°; after 8 days at 30°, 0·82 g. of the same compound, m. p. 111°, and m. p. 113—115°, $[\alpha]_D^{20^\circ}$ + 7·3°, after two recrystallisations from alcohol; after 1 hour at 70°, 0·51 g., m. p. 113—114°; after 1 hour at 80°, 0·40 g., m. p. 114°; after 1 hour at 90°, 0·25 g., m. p. 113—114°; after 1 hour at 100°, 0·30 g. of penta-acetyl gluconpremitrile, m. p. 83—84°, $[\alpha]_D^{20^\circ}$ + 48·4°; after 1 hour at 110°, 0·33 g. of the nitrile, m. p. 83°.

From the mother-liquors of the experiments carried out at 70—90°, minute quantities of penta-acetyl gluconpremitrile, m. p. 82°, were obtained.

With reagent I, mannoseoxime gave : after 8 days at 0°, 1·3 g. of hexa-acetylated oxime, m. p. 94°, $[\alpha]_D^{20^\circ}$ − 8·4°, and a minute quantity of penta-acetyl mannononitrile, m. p. 93°; after 8 days at 30°, 1·1 g. of the nitrile, m. p. 92—93°, $[\alpha]_D^{30^\circ}$ − 1·2°. At higher temperatures the nitrile only was produced.

With reagent II, glucoseoxime gave : after 8 days at 0°, 1·5 g. of the hexa-acetylated oxime, m. p. 112—113°, $[\alpha]_D^{20^\circ}$ + 7·4°; after 8 days at 30°, 1·45 g. of the oxime, m. p. 111—113°; after 2 hours at 60°, 0·70 g. of the oxime, m. p. 113—114°, and very little nitrile, m. p. 83°; after 1 hour at 70°, 0·25 g. of penta-acetyl gluconpremitrile, m. p. 84°. Above 70°, only the nitrile was obtained.

With reagent II, mannoseoxime gave : after 8 days at 0°, 0·25 g. of the hexa-acetylated oxime, m. p. 94°, $[\alpha]_D^{20^\circ}$ − 8·3°, and 0·2 g. of penta-acetyl mannononitrile, m. p. 93°; after 8 days at 30°, 1 g. of the nitrile, m. p. 93°, $[\alpha]_D^{30^\circ}$ − 1·3°. Above 30°, only the nitrile was obtained.

Hexa-acetyl Aldomannoseoxime.—A suspension of 5 g. of mannoseoxime in 31·5 c.c. of pyridine at 0° was treated with 21 c.c. of acetic anhydride and kept at 0°, with frequent shaking, for 8 days. The solution then obtained was poured into 200 c.c. of ice-water and after some hours the crystals produced were collected, washed with water, and dried; yield 6·7 g., m. p. 90°. *Hexa-acetyl mannoseoxime* was obtained, after recrystallisation from alcohol, in six-sided plates, m. p. 94°, $[\alpha]_D^{20^\circ}$ − 8·3°, almost insoluble in water, soluble in alcohol, and very soluble in chloroform (Found : N, 3·2. $C_{18}H_{25}O_{12}N$ requires N, 3·1%). Mixed with penta-acetyl mannononitrile (m. p. 93°), it melted at 80°.

From the aqueous solution, chloroform extracted penta-acetyl mannononitrile, m. p. 93°, after being washed (dilute sulphuric acid, dilute sodium carbonate solution, and water) and dried in the extract, recovered in a vacuum, and recrystallised from alcohol (yield, 0·2 g.).

The acetylated oxime was recovered unchanged after being heated for 1 hour at 90° with fused sodium acetate and acetic anhydride or with pyridine and acetic anhydride. Heating with the latter reagents for 1 hour at 110° produced a substance, m. p. 80°, which was doubtless a mixture of the nitrile and the unchanged oxime.

The acetylated oxime (1 g.) was heated at 130° for 10 minutes. The product, recrystallised from alcohol, was shown to be penta-acetyl mannononitrile by its m. p. 93° and mixed m. p.

A solution of the hexa-acetyl aldomannoseoxime (1 g.) in 25 c.c. of methyl alcohol was saturated with dry ammonia, and evaporated in a vacuum after 24 hours. The product, recrystallised from alcohol–water, had m. p. 176°, alone or mixed with authentic mannoseoxime—this is a proof that the acetylation has not permanently modified the structure of the original oxime.

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