Note

A new synthesis of 2,3,4,6-tetra-*O*-acetyl-β-D-glucopyranosyl azide

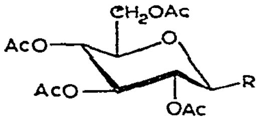
O. L. GALMARINI AND I. O. MASTRONARDI

Cátedra de Química Orgánica, Facultad de Ingeniería, Universidad de Buenos Aires, Paseo Colón 850, Buenos Aires (Argentina)

(Received October 18th, 1971)

Wolfrom and coworkers[1] described the synthesis of *aldehydo*-D-glucose pentaacetate by the action of nitrous acid on the semicarbazone of *aldehydo*-D-glucose pentaacetate. According to them, the latter compound (m.p. 155°) could be obtained as the principal product by acetylation of *aldehydo* D-glucose semicarbazone. Among other products, an isomeric pentaacetate, of m.p. 238°, was isolated in small yield; the structure of this compound was not fully described, but it was assumed to be a *N*-acetylated, cyclic compound.

In our laboratory, when the same reaction was conducted, but with use of larger excesses of pyridine and acetic anhydride, the peracetate having m.p. 238° was obtained as the main product. The p.m.r. spectrum of this compound in two different solvents was recorded. In chloroform-*d*, the following signals were observed: a doublet at τ 4.14 ($J_{1,2}$ 9 Hz) attributable to H-1, and the fact that the signal from the anomeric proton appeared as a doublet (instead of a triplet) clearly indicated the lack of a hydrogen atom on the nitrogen atom attached to C-1; a complex pattern for three protons between τ 4.50 and 5.00; a very complicated signal (3 H) between τ 5.50 and 6.10; and three singlets (that accounted for 15 protons) at τ 7.85, 7.93, and 7.98, respectively, that were attributed to five acetyl groups. When the spectrum was determined for a solution in trifluoroacetic acid, much better resolution was achieved. The following assignments could be made: τ 3.84 (doublet, 1 H, $J_{1,2}$ 9 Hz, axial H-1), and, as before, the absence of any triplet at that field value pointed to the fact that no hydrogen atom was attached to the nitrogen atom on C-1, indicating that an acetyl group was attached to this nitrogen atom; τ 4.27 (triplet, 1 H, J 9 Hz, H-4); τ 4.63 (triplet, 1 H, J 9 Hz, H-2 or H-3); τ 4.66 (triplet, 1 H, J 9 Hz, H-2 or H-3); τ 5.55 (broad signal, 2 H, $-CH_2-$); τ 5.90 (complex signal, 1 H, H-5); five



1 $R = NAc{-}NH{-}CO{-}NH_2$

2 $R = N{=}\overset{+}{N}{=}\overset{-}{N}$

Carbohyd. Res., 21 (1972) 476–478

singlets (3 H each), at τ 7.64, 7.73, 7.76, 7.80, and 7.82, which were assigned to the acetyl groups. These data suggest the structure **1** for the peracetate having m.p. 238°, namely, 1-acetyl-1-(2,3,4,6-tetra-*O*-acetyl-β-D-glucopyranosyl)semicarbazide.

When compound **1** was treated with nitrous acid, a product melting at ~127° was obtained in good yield. In its infrared (i.r.) spectrum, it showed a typical azide band (2100 cm^{-1}), with the carbonyl stretching appearing at 1740 cm^{-1}. Its p.m.r. spectrum showed a complex signal (for two protons) between τ 4.69 and 4.98; a doublet at τ 5.13 ($J_{1,2}$ 8.5 Hz) that could be attributed to H-1 axially attached; a triplet at τ 5.30 (*J* 9 Hz) attributable to H-2 or H-3; an unresolved signal at τ 5.77 ($-CH_2-$), and a broad signal at 6.17 (H-5); at higher field, there appeared four sharp singlets (3 H each), at τ 7.90, 7.93, 7.97, and 8.00, assigned to four acetyl groups. To this product, the structure of 2,3,4,6-tetra-*O*-acetyl-β-D-glucopyranosyl azide (**2**) was assigned, and its identity was confirmed by comparison of its i.r. spectrum with that obtained for an authentic sample of **2** prepared by reaction of 2,3,4,6-tetra-*O*-acetyl-α-D-glucopyranosyl bromide with sodium azide[2].

As it was already known that azides can be prepared by the action of nitrous acid on monosubstituted hydrazines[3], the reaction here described may tentatively be considered to be a particular case of the same general procedure. Extension of this work to other acetylated sugar semicarbazones is in progress in this laboratory.

EXPERIMENTAL

General methods. — Melting points are uncorrected. I.r. spectra were recorded with a Perkin–Elmer model 137 Infracord spectrophotometer. P.m.r. spectra were recorded with a Varian A-60 n.m.r. spectrometer, with tetramethylsilane as the internal standard and to provide a lock signal. Solvents were removed under diminished pressure below 40°.

*1-Acetyl-1-(2,3,4,6-tetra-*O*-acetyl-β-D-glucopyranosyl)semicarbazide* (**1**). — A mixture of D-glucose semicarbazone[4] (880 mg), dry pyridine (15 ml), and acetic anhydride (21.4 ml) was stirred at room temperature until complete dissolution had occurred (2 h), and the solution was kept for 48 h. On cooling and scratching, a precipitate formed. This was filtered off, and on recrystallization from water, compound **1** (545 mg), m.p. 238°, was obtained.

The filtrate was poured into ice–water (50 ml), and the mixture was extracted with several portions of chloroform. The extracts were combined, successively washed with dilute sulfuric acid, saturated sodium hydrogen carbonate solution, and water, dried (sodium sulfate), and evaporated. The crystalline residue was recrystallized from water, to yield a second crop of **1** (223 mg), m.p. 238°, $[\alpha]_D^{24}$ −13.0° (*c* 1, chloroform). For p.m.r. data on **1**, see the Introduction.

Anal. Calc. for $C_{17}H_{25}N_3O_{11}$: C, 45.64; H, 5.59; N, 9.39; acetyl, 38.48. Found: C, 45.71; H, 5.63; N, 9.20; acetyl, 38.64.

*2,3,4,6-Tetra-*O*-acetyl-β-D-glucopyranosyl azide* (**2**). — Compound **1** (200 mg) was dissolved in boiling water (7 ml), and to the hot solution was added 5% sodium nitrite (12.5 ml) with stirring; then, 50% hydrochloric acid (2 ml) was added dropwise. After several minutes, sodium nitrite (500 mg) and 50% hydrochloric acid (1 ml) were added; this operation was repeated twice more. After about 15 min, white needles appeared. The mixture was extracted with chloroform (3 × 20 ml), and the extracts were combined, successively washed with saturated sodium hydrogen carbonate solution and water, dried (sodium sulfate), and evaporated, to give a crystalline residue which was recrystallized from methanol, yielding pure **2** (58.5 mg), m.p. 127–128° (dec.), $[\alpha]_D^{21}$ $-35°$ (*c* 1, chloroform); $-40°$ (*c* 1, methanol); lit.[2] m.p. 129° (dec.); $[\alpha]_D$ -32.5 to $-33°$ (chloroform); $-41.7°$ (methanol). For i.r. and p.m.r. data, see the Introduction.

Anal. Calc. for $C_{14}H_{19}N_3O_9$: C, 45.03; H, 5.39; N, 11.26. Found: C, 45.39; H, 5.43; N, 10.96.

ACKNOWLEDGMENTS

We thank Dr. B. B. de Deferrari for the microanalyses, Dr. E. G. Gros for the i.r. and p.m.r. spectra, and the University of Buenos Aires for a grant.

REFERENCES

1 M. L. Wolfrom, L. W. Georges, and S. Soltzberg, *J. Amer. Chem. Soc.*, 56 (1934) 1794.
2 A. Bertho and H. Nussell, *Ber.*, 63 (1930) 836.
3 A. Angeli, *Atti Accad. Lincei*, 6 (1927) 732.
4 M. M. Maquenne and W. Goodwin, *Bull. Soc. Chim. Fr.*, 31 (1904) 1075.