Note

A novel approach towards acyclic 2-deoxyaldose derivatives*

ISTVÁN PINTÉR[†], VIRÁG ZSOLDOS-MÁDY, ANDRÁS MESSMER[†], PÉTER SÁNDOR, Central Research Institute for Chemistry, Hungarian Academy of Sciences, H-1525 Budapest (Hungary)

AND STEPHAN D. GERO

C.N.R.S. l'Institut de Chimie des Substances Naturelles, F-91190 Gif-sur-Yvette (France) (Received July 15th, 1987; accepted for publication, September 14th, 1987)

Due to the activating effect of the formazyl moiety, AcO-2 of acetylated acyclic aldose diphenylformazans can be replaced by nucleophiles under mild conditions. Thus, with sodium methoxide, the products were either 2,5-anhydro-¹ or 2-*O*-methyl-aldose diphenylformazans; with ammonia, 2-acetamido-2-deoxyaldose diphenylformazans² were obtained.

These results prompted an extension of the studies to other nucleophiles. Thus, in accordance with the proposed nucleophilic 1,4-elimination-addition mechanism² of the reaction, when penta-O-acetyl-D-glucose N, N'-diphenyl-formazan³ (1) or its mannose epimer³ (2) were treated with sodium borohydride in ice-cold aqueous 2-methoxyethanol, the replacement of AcO-2 by hydride gave 2-deoxy-D-arabino-hexose diphenylformazan (3), which was characterised as the tetra-acetate 4.



^{*}Dedicated to Professor Rezső Bognár in the year of his 75th birthday. *Authors for correspondence.

The formazyl structure of **3** and **4** was corroborated by λ_{max} values in the visible spectra and by the formazyl N-H signal at δ 11.04 p.p.m. in the ¹H-n.m.r. spectrum of **4**. Chemical evidence for the formazyl group was provided by transforming **4** into the corresponding tetrazolium fluoroborate (**5**).

The 2-deoxy structure of the sugar chain was proved by the ¹H-n.m.r. spectrum of 4, which contained signals for H-2a,2b at δ 3.08 and 2.85 in addition to the pattern of H-6a,6b at δ 4.32 and 4.19.

Under the conditions of reaction of 1 with borohydride, penta-O-acetyl-D-galactose diphenylformazan³ (6) afforded 2-deoxy-D-lyxo-hexose diphenylformazan (7) identical with the product synthesised¹ from tetra-O-acetyl-2-deoxyaldehydo-D-lyxo-hexose⁴ by the regular formazan reaction³ and subsequent deacetylation. Tetra-O-acetyl-2-deoxy-D-lyxo-hexose diphenylformazan¹ (8) was identical with the compound prepared by acetylation of 7.



Due to the bis(phenylazo)hexene structure² of the intermediate 9, the replacement of AcO-2 by hydride anion is highly regiospecific and the procedure should provide a new access to 2-deoxy sugar derivatives.

EXPERIMENTAL

General. — T.l.c. was performed on Silica Gel F_{254} (Merck) with A, ethyl acetate-1,4-dioxane-carbon tetrachloride-2-propanol (3:3:3:0.5); or B, dichloromethane-ethyl acetate (9:1). N.m.r. measurements were performed with a Varian XL-100-15 F.t. spectrometer on solutions in CDCl₃ (internal Me₄Si). U.v. and visible spectra were recorded with a Unicam SP 800 spectrometer. Microanalyses were performed in the Microanalytical Laboratory of the Institute.

2-Deoxy-D-arabino-hexose N,N'-diphenylformazan (3). — (a) To a stirred and cooled solution of 1 (2.0 g, 3.4 mmol) in 2-methoxyethanol (45 mL) was added an ice-cold aqueous solution (13 mL) of sodium borohydride (4.0 g, 10.6 mmol), and the mixture was stored overnight when t.l.c. (solvent A) revealed no 1. The

excess of borohydride was decomposed with acetic acid at <10°, the suspension was poured into water (600 mL), and the red precipitate (1.17 g, 95%), m.p. 175–176°, was recrystallised from ethyl acetate to afford red crystals of **3**, m.p. 181°, $\lambda_{\text{max}}^{\text{EiOH}}$ 417 nm.

Anal. Calc. for C₁₈H₂₂N₄O₄: C, 60.32; H, 6.19; N, 15.63. Found: C, 60.36; H, 6.56; N, 15.55.

(b) A solution of 2 (6.0 g, 10.2 mmol) in 2-methoxyethanol (135 mL) was treated with sodium borohydride (12.0 g, 0.318 mol) as in (a), to afford 3 (2.26 g, 62%), m.p. 181°, λ_{max}^{EtOH} 417 nm.

3,4,5,6-Tetra-O-acetyl-2-deoxy-D-arabino-hexose N,N'-diphenylformazan (4). — Conventional treatment of **3** with acetic anhydride–pyridine gave red crystals which were recrystallised from 95% ethanol to give **4** (63%), m.p. 116–117°, λ_{max}^{EtOII} 426 nm. ¹H-N.m.r. data (100 MHz): δ 11.04 (s, 1 H, N-H), 5.67 (m, 1 H, $J_{3,4}$ 2.8 Hz, H-3), 5.52 (dd, 1 H, $J_{4,5}$ 8.0 Hz, H-4), 5.27 (m, 1 H, $J_{5,6a}$ 3.0, $J_{5,6b}$ 5.3 Hz, H-5), 4.32 (dd, 1 H, $J_{6a,6b}$ 12.4 Hz, H-6a), 4.19 (dd, 1 H, H-6b), 3.08 (dd, 1 H, $J_{2a,3}$ 6.0 Hz, H-2a), 2.85 (dd, 1 H, $J_{2b,3}$ 7.5, $J_{2a,2b}$ 15.3 Hz, H-2b), 1.98 (s, 6 H, OAc), 2.04 (s, 3 H, OAc), and 2.12 (s, 3 H, OAc).

Anal. Calc. for C₂₆H₃₀N₄O₈: C, 59.31; H, 5.74; N, 10.64. Found: C, 59.12; H, 6.03; N, 10.62.

2,3-Diphenyl-5-(2,3,4,5-tetra-acetoxy-D-arabino-pentyl)tetrazolium fluoroborate (5). — A solution of **4** (0.45 g, 0.85 mmol) in dichloromethane (5 mL), on treatment with N-bromosuccinimide (0.5 g, 2.8 mmol) in dichloromethane (12 mL), became pale yellow within 5 min. Addition of ether (100 mL) precipitated a syrup that was triturated with ether (100 mL) to give a yellow solid, a solution of which in ethanol (10 mL) was boiled under reflux for 10 min, then cooled, and diluted with ether to precipitate the crude tetrazolium bromide salt (0.24 g). An aqueous solution of the salt was mixed with aqueous sodium fluoroborate, and the white precipitate was crystallised from ethanol to afford white needles of **5**, m.p. 166– 167°. ¹³C-N.m.r. data (25 MHz): δ 170.5, 170.3, 169.9 (CO), 164.7 (C-1), 133.8, 133.3, 130.3, 126.5 (phenyl-C), 70.3, 68.9, 68.1 (C-3,4,5), 62.0 (C-6), 28.4 (C-2), 20.8, and 20.6 (Ac-Me).

Anal. Calc. for C₂₆H₂₉BF₄N₄O₈: C, 50.99; H, 4.77; N, 9.16. Found: C, 52.46; H, 4.37; N, 8.79.

2-Deoxy-D-lyxo-hexose N,N'-diphenylformazan (7). — A solution of 6 (2.0 g, 3.4 mmol) in 2-methoxyethanol (45 mL) was treated with sodium borohydride (4.0 g, 10.6 mmol) as for 1. The red product (0.64 g, 53%) was recrystallised from benzene-methanol (95:5) to give 7 as a red solid, m.p. 114–116°, $\lambda_{\text{max}}^{\text{EtOH}}$ 421 nm, which was identical with an authentic¹ sample.

ACKNOWLEDGMENTS

The authors thank Dr. A. Neszmélyi for recording and interpreting the ¹³Cn.m.r. spectrum of **5**, and Mrs. M. Pintér for valuable technical assistance.

REFERENCES

- 1 V. ZSOLDOS-MÁDY, A. MESSMER, I. PINTÉR, AND A. NESZMÉLYI, Carbohydr. Res., 62 (1978) 105-116.
- 2 A. MESSMER, I. PINTÉR, V. ZSOLDOS-MÁDY, A. NESZMÉLYI, AND J. HEGEDÜS-VAJDA, Acta Chim. Hung., 113 (1983) 393-402.
- 3 L. MESTER, Adv. Carbohydr. Chem., 13 (1958) 105-167.
- 4 J. L. BARCLAY, A. J. CLEAVER, A. B. FOSTER, AND W. G. OVEREND, J. Chem. Soc., (1956) 789-790.