Carbohydrate Research, 64 (1978) 289–292

Note

Structure and reactions of L-rhamnose benzoylhydrazone tetra-acetates

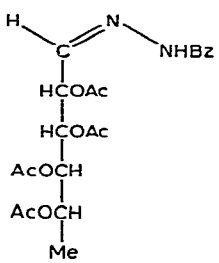
LÁSZLÓ SOMOGYI

Chemical Research Group for Antibiotics of the Hungarian Academy of Sciences, H-4010 Debrecen (Hungary)

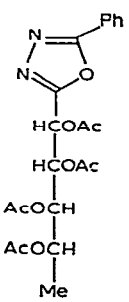
(Received August 8th, 1977; accepted for publication, September 16th, 1977)

Shaban and Nassr[1] have reported that treatment of L-rhamnose benzoylhydrazone with acetic anhydride–pyridine at room temperature gave the acyclic tetra-acetate **1** [m.p. 210–211° (from benzene); ν_{max}^{KBr} 3300 (NH), 1745 (OAc), 1650 (amide I), 1525 (amide II), 755 and 675 cm^{-1} (Ph)]. Iodine and yellow mercuric oxide in dry ether did not convert **1** into 5-phenyl-2-(L-*manno*-1,2,3,4-tetra-acetoxypentyl)-1,3,4-oxadiazole (**2**), and this was attributed to the existence of **1** in the *anti* form.

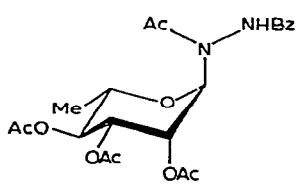
Since treatment[2] of D-galactose benzoylhydrazone and its penta-acetate with



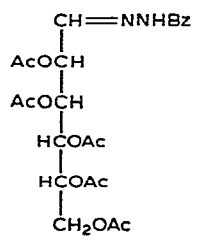
1



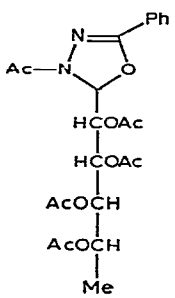
2



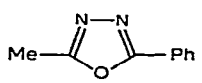
3



4



5



6

acetic anhydride in the presence of acidic or basic catalysts gave diastereoisomeric 3-acetyl-2-(D-*galacto*-1,2,3,4,5-penta-acetoxypentyl)-5-phenyl-1,3,4-oxadiazolines, we have re-examined the acetylation of L-rhamnose benzoylhydrazone.

L-Rhamnose benzoylhydrazone, which mutarotates in aqueous solution {$[\alpha]_D^{23}$ $+68 \rightarrow +33°$ (24 h, *c* 0.5)}, indicating the possible presence of a cyclic form, gave, after acetylation under the conditions of Shaban and Nassr, a tetra-acetate which, on the basis of optical rotation {$[\alpha]_D^{23}$ $-68°$ (*c* 1, chloroform)} and p.m.r. data (Experimental), must have the α-pyranoid structure **3**. The tetra-acetate **3** could be recovered unchanged after treatment with boiling acetic anhydride for 2 h.

The acyclic tetra-acetate **1**, synthesised unambiguously by reaction of tetra-*O*-acetyl-*aldehydo*-L-rhamnose[3] with benzoylhydrazine, was amorphous and had solubility and physical constants similar to those of amorphous penta-*O*-acetyl-*aldehydo*-D-mannose benzoylhydrazone (**4**) prepared from penta-*O*-acetyl-*aldehydo*-D-mannose ethyl hemiacetal[4] by reaction with benzoylhydrazine, but markedly different from those of **3**. Moreover, treatment of authentic **1** with acetic anhydride and anhydrous zinc chloride gave 3-acetyl-5-phenyl-2-(L-*manno*-1,2,3,4-tetra-acetoxypentyl)-1,3,4-oxadiazoline (**5**). Under similar conditions, the tetra-acetate **3** gave, after chromatography, syrupy 1,2,3,4-tetra-*O*-acetyl-α-L-rhamnopyranose and 2-methyl-5-phenyl-1,3,4-oxadiazole (**6**).

The foregoing data indicate that the tetra-acetate described by Shaban and Nassr does not have the acyclic structure **1**, but has the pyranoid structure **3**.

EXPERIMENTAL

General methods. — Melting points (uncorrected) were determined on a Kofler block. I.r. spectra were recorded with a Unicam SP 200 spectrophotometer for KBr discs, and p.m.r. spectra with a JEOL JNM-100 spectrometer for solutions in $CDCl_3$ (internal Me_4Si). Optical rotations were measured with a Schmidt and Haensch polarimeter (1-dm pathlength). Solutions were concentrated *in vacuo* at $\gtrsim 60°$ (bath).

Tetra-O-*acetyl*-aldehydo-L-*rhamnose benzoylhydrazone* (**1**). — A solution of syrupy tetra-*O*-acetyl-*aldehydo*-L-rhamnose[3] (3.144 g, 9.46 mmol) and benzoylhydrazine (1.21 g, 8.89 mmol) in ethyl acetate (5 ml) was kept at 45° for 48 h, and then concentrated. A solution of the residue in benzene (25 ml) was poured into light petroleum (350 ml) to give amorphous **1** (3.414 g, 85.3%), a portion (1.5 g) of which was eluted from a column (100 g, 25 cm) of Kieselgel 40 with benzene–ethyl acetate (2:1) to give **1** (0.61 g), $[\alpha]_D^{23}$ $-44°$ (*c* 1, chloroform); ν_{max} 3230 (NH), 1658 (amide I), and 1548 cm^{-1} (amide II). P.m.r. data: δ 10.24 (s, 1 H, exchangeable with deuterium, CON*H*), 7.28–7.82 (m, 6 H, Ph and C*H*=N), 4.90–5.44 (m, 4 H, H-2,3,4,5), 1.98–2.08 (4 Ac), and 1.18 (d, 3 H, $J_{5,6}$ 6 Hz, Me).

Anal. Calc. for $C_{21}H_{26}N_2O_9$: C, 55.99; H, 5.82; N, 6.22. Found: C, 55.67; H, 5.95; N, 6.23.

1-Acetyl-2-benzoyl-1-(2,3,4-tri-O-*acetyl*-α-L-*rhamnopyranosyl)hydrazine* (**3**). — L-Rhamnose benzoylhydrazone[1] (2 g) was treated with pyridine (30 ml) and acetic

anhydride (30 ml) for 24 h at room temperature. The mixture was concentrated to 10 ml, and then poured into ice and water. The product was collected, washed with water, and dried, and a solution in chloroform was decolourised and then concentrated. Crystallisation of the residue from benzene gave **3** (2.23 g, 70%), m.p. 212–213°, $[\alpha]_D^{23}$ −68° (*c* 1, chloroform); ν_{max} 1690 (amide I) and 1523 cm^{-1} (amide II). P.m.r. data: δ 8.55 (s, 1 H, exchangeable with deuterium, CON*H*); 7.43–7.83 (m, 5 H, Ph); 4.86–5.04 (2 H), 5.58 (1 H), and 5.95 (1 H) (H-1,2,3,4); 3.70 (m, 1 H, H-5); 1.65, 1.90, 2.04, and 2.10 (4 s, 4 Ac); and 1.28 (d, 3 H, $J_{5,6}$ ~5 Hz, Me).

Anal. Calc. for $C_{21}H_{26}N_2O_9$: C, 55.99; H, 5.82; N, 6.22. Found: C, 56.76; H, 5.92; N, 6.45.

*Penta-*O*-acetyl-*aldehydo-D-*mannose benzoylhydrazone.* — A solution of penta-*O*-acetyl-*aldehydo*-D-mannose ethyl hemiacetal[4] (7.419 g, 17 mmol) and benzoylhydrazine (2.315 g, 17 mmol) in ethyl acetate (15 ml) was boiled under reflux for 2 h and then concentrated. A solution of the syrupy residue in benzene (30 ml) was decolourised and then poured into light petroleum (500 ml). The amorphous product was collected, washed with light petroleum, and dried *in vacuo* to give chromatographically pure, title product (8.514 g, 98.5%), $[\alpha]_D^{23}$ +24° (*c* 1, chloroform). P.m.r. data: δ 10.38 (s, 1 H, exchangeable with deuterium, CON*H*), 7.32–7.82 (m, 6 H, Ph and C*H*=N), and 2.00–2.06 (5 Ac).

Anal. Calc. for $C_{23}H_{28}N_2O_{11}$: C, 54.33; H, 5.55; N, 5.51. Found: C, 54.31; H, 5.72; N, 5.56.

3-Acetyl-5-phenyl-2-(L-manno-*1,2,3,4-tetra-acetoxypentyl*)*-1,3,4-oxadiazoline* (**5**). — A solution of **1** (6 g, 13.32 mmol) in acetic anhydride (120 ml) containing anhydrous zinc chloride (12 g) was kept at room temperature for 24 h, and then concentrated. The residue was treated with ice and water, and a solution of the resulting gum in chloroform was washed successively with water, aqueous sodium hydrogen carbonate, and water, dried ($MgSO_4$), decolourised, and concentrated. Trituration of the syrupy residue with di-isopropyl ether (10 ml) gave the crude product {3 g, 45.7%, m.p. 153.5–155°, $[\alpha]_D^{23}$ −255.5° (*c* 1, chloroform)}, which was recrystallised from di-isopropyl ether to give **5**, m.p. 156°, $[\alpha]_D^{23}$ −256° (*c* 1, chloroform); ν_{max} 1674 and 1669 sh (amide I), and 1637 cm^{-1} (C=N). P.m.r. data: δ 7.36–7.90 (m, 5 H, Ph); 6.23 (s, 1 H, O-C*H*R-N); 4.88–5.74 (4 H, H-1,2,3,4); 1.92, 2.07, 2.10, 2.17, and 2.23 (5 s, 5 Ac); and 1.19 (d, 3 H, $J_{5,6}$ 6 Hz, Me).

Anal. Calc. for $C_{23}H_{28}N_2O_{10}$: C, 56.09; H, 5.73; N, 5.69. Found: C, 56.25; H, 5.85; N, 5.89.

Acetolysis of **3**. — A solution of **3** (5 g) in acetic anhydride (100 ml) containing anhydrous zinc chloride (10 g) was kept at 80° for 1 h, and then concentrated. The residue was treated with ice and water, and a solution of the resulting gum in chloroform was washed successively with water, aqueous sodium hydrogen carbonate, and water, dried ($MgSO_4$), and concentrated. A solution of the residue in benzene (~100 ml) was decolourised, and concentrated to give a syrupy residue (4.7 g), a portion (2 g) of which was eluted from a column (27 cm) of Kieselgel 40 (100 g) with benzene–ethyl acetate (3:1) to give, first, syrupy 1,2,3,4-tetra-*O*-acetyl-α-L-

rhamnopyranose (1.30 g, 83%), $[\alpha]_D^{23}$ −54° (*c* 1, chloroform); lit.[5] $[\alpha]_D^{23}$ −63° (*c* 2.3, chloroform). P.m.r. data: δ 5.98 (s, 1 H, $J_{1,2}$ <1 Hz); 4.97–5.40 (m, 3 H, H-2,3,4); 3.92 (m, 1 H, H-5); 1.98, 2.05, 2.14, and 2.15 (4 s, 4 Ac); in agreement with the literature data[5]. Eluted second was 2-methyl-5-phenyl-1,3,4-oxadiazole (0.37 g, 49%), m.p. 65° (from methanol–water); lit.[6] m.p. 67°.

ACKNOWLEDGMENTS

The author thanks Miss I. Simon for the preparation of *aldehydo*-sugar acetates, Miss M. Kiss and Mrs. M. Lovas for the microanalyses, and Mrs. E. Tóth and Mr. A. Löki for recording the i.r. and p.m.r. spectra.

REFERENCES

1 M. Shaban and M. Nassr, *Org. Prep. Proced. Int.*, 8 (1976) 107–112.
2 L. Somogyi, *Carbohydr. Res.*, 54 (1977) c14–c16.
3 M. L. Wolfrom, M. Konigsberg, and F. B. Moody, *J. Am. Chem. Soc.*, 62 (1940) 2343–2349.
4 M. L. Wolfrom, M. Konigsberg, and D. I. Weisblat, *J. Am. Chem. Soc.*, 61 (1939) 574–576.
5 G. M. Bebault, G. G. S. Dutton, and C. K. Warfield, *Carbohydr. Res.*, 34 (1974) 174–179.
6 R. Stollé, *Ber.*, 45 (1912) 273–289.