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Note

Reaction of 1,2:5,6-di-*O*-isopropylidene-α-D-*ribo*-hexofuranos-3-ulose benzoylhydrazone with acetic anhydride*

El Sayed H. El Ashry**, Mohamed A. Abdel Rahman, Yeldez El Kilany, and Nagwa Rashed
Chemistry Department, Faculty of Science, Alexandria University, Alexandria (Egypt)

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Oxadiazoles and oxadiazolines have a wide spectrum of properties[2-7]. However, the synthesis of such heterocycles linked to carbohydrate residues has been only recently investigated[8] and involved the aldehyde function. We now report the synthesis of an oxadiazole derivative with a spiral junction to C-3 of a hexose and the confirmation of its structure by comparison of the ^{13}C-n.m.r. spectrum with those of model compounds.

Reaction of 1,2:5,6-di-*O*-isopropylidene-α-D-*ribo*-hexofuranos-3-ulose[9] (**1**) or its hydrate **2** with benzoylhydrazine afforded the benzoylhydrazone **3**. Treatment of **3** with boiling acetic anhydride afforded a crystalline product, the elemental analysis of which indicated the introduction of one acetyl group and which had an i.r. band at 1690 cm^{-1} (NAc) but none for NH. The shift of the NAc band to a lower frequency compared to that of **3** rules out an *N*-acetylated hydrazone structure. The structures **6** and/or **7** were confirmed by comparison of the ^{13}C-n.m.r. data of **6** and the model compounds **9** and **10** prepared by treatment of the benzoylhydrazones of acetone and benzaldehyde, respectively, with acetic anhydride. The signal at δ 100.2 for **9** is assigned to C-2 and reflects the shielding associated with its attachement to two heteroatoms, instead of the anticipated down-field signal of the corresponding carbon (C = N) in its hydrazone precursor; C-5 resonated at δ 153.5. The corresponding signals for **10** were at δ 92.3 and 155.9 and for **6** at δ 102.9 (coincident with the signal for C-1) and 151.0.

The generation of a new chiral centre during the formation of the oxadiazole ring in **3** results in the formation of diastereoisomers (**6** and **7**) as deduced from the ^{13}C-n.m.r. spectrum, but one of them was preponderant.

Formation of the oxadiazole ring in **6** could occur *via* **4** and **5** (*cf.* ref. 10). Alternatively, addition of acetic anhydride to **4** could occur with subsequent enolis-

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*Heterocycles from Carbohydrate Precursors, Part 34. For Part 33, see ref. 1.
**To whom enquiries should be addressed.

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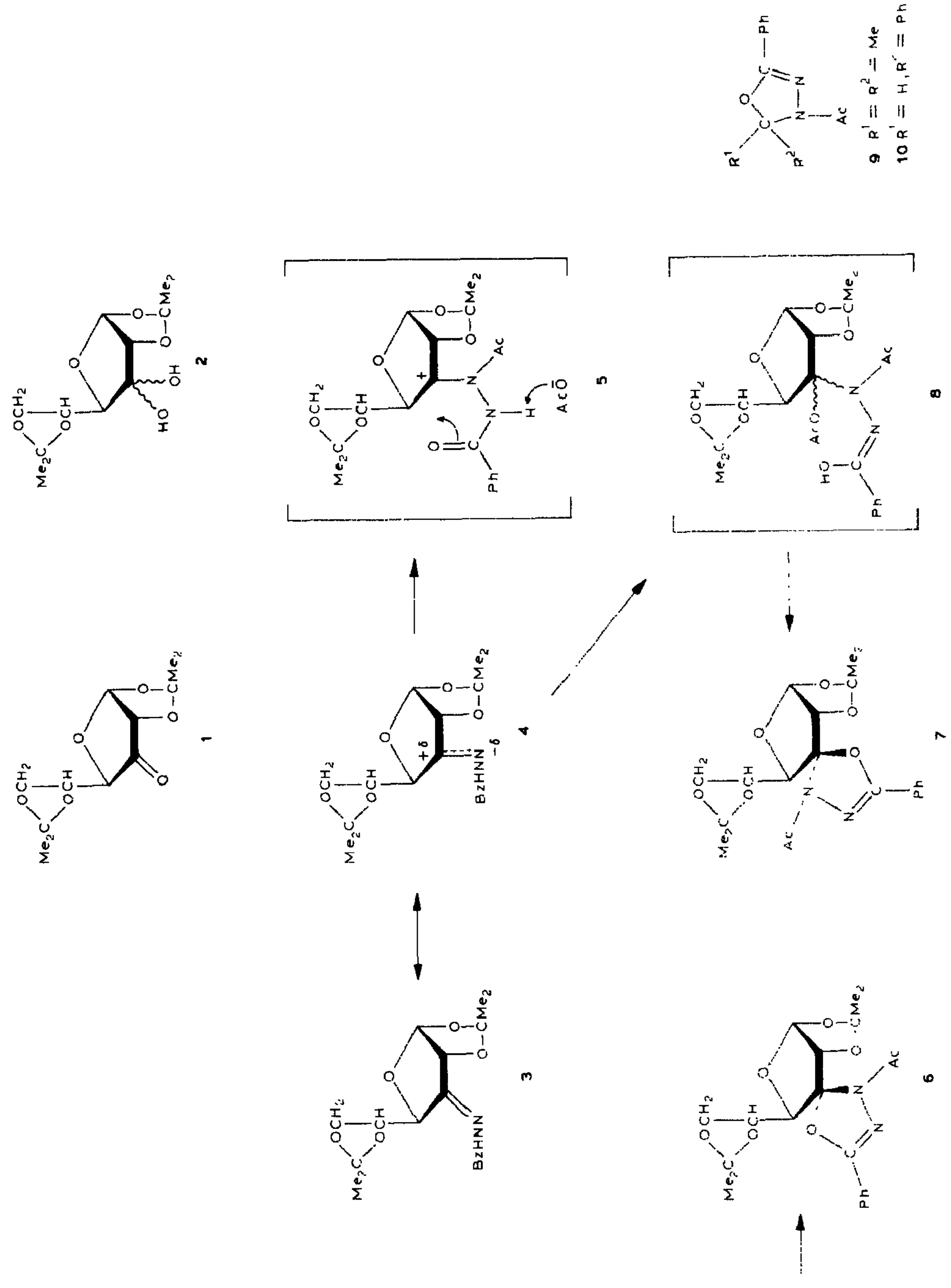
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3
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5
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9 R¹ = R² = Me
10 R¹ = H, R² = Ph

ation to **8** and then elimination of acetic acid. The formation of different proportions of diastereoisomers **6** and **7** indicated that steric factors determined the preferred configuration of the newly formed asymmetric centre. However, the specific configuration of **6** and **7** could not be determined.

EXPERIMENTAL

General methods. — Melting points were determined with a Kofler block and are uncorrected. I.r. spectra were recorded with a Unicam SP-200 spectrometer, and ^{1}H- and ^{13}C-n.m.r. spectra ($CDCl_3$, internal Me_4Si) with a Varian EM-390 and a Jeol-100 spectrometer, respectively. Microanalyses were performed in the Chemistry Department, Cairo University.

*1,2:5,6-Di-O-isopropylidene-α-*D-ribo*-hexofuranos-3-ulose benzoylhydrazone* (**3**). — A solution of **2**[9] (0.3 g, 1.18 mmol) in the minimum volume of methanol was treated with benzoylhydrazine (0.16 g, 1.18 mmol), and the mixture was heated on a water bath for 10 min and then cooled. The product (92%) was collected, washed with methanol, dried, and crystallised from methanol to give **3** as colourless needles, m.p. 174–176°, $[\alpha]_D^{25}$ +2.6° (*c* 2, chloroform); ν_{max}^{Nujol} 3220 (NH), 1660 (OCN), and 1610 cm^{-1} (C=N). ^{1}H-N.m.r. data: δ 7.32–7.90 (2 d, 5 H, aromatic protons), 11.31 (s, 1 H, NH disappeared upon the addition of D_2O), 5.77 (d, 1 H, H-1), 5.05 (d, 1 H, H-2), 4.58 (d, 1 H, H-4), 4.0–4.24 (m, 3 H, H-5,6,6′), 1.55, 1.45, 1.38, and 1.32 (4 s, 12 H, 4 CH_3).

Anal. Calc. for $C_{19}H_{24}N_2O_6$: C, 60.6; H, 6.4; N, 7.4. Found: C, 60.5; H, 6.5; N, 7.7.

Reaction of **3** *with acetic anhydride.* — A solution of **3** (1.5 g, 4.0 mmol) in acetic anhydride (3 mL) was boiled under reflux for 2 h, then cooled, poured onto crushed ice, and neutralised with cold aqueous potassium hydroxide. The solid (78%) was collected, washed with water, dried, and crystallised from ethanol to give 3′-acetyl-5-(2,2-dimethyl-1,3-dioxolan-4-yl)-3a,6a-dihydro-2,2-dimethyl-5′-phenylspiro{furo[2,3-*d*]-1,3-dioxole-6(5*H*),2′(3′*H*)-[1,3,4]-oxadiazole} (**6** and **7**) as colourless needles, m.p. 192–194°, $[\alpha]_D^{25}$ +3.2° (*c* 1.3, chloroform); ν_{max}^{Nujol} 1690 cm^{-1} (NAc). N.m.r. data: ^{1}H, δ 7.20–7.90 (2 m, 5 H, Ph), 5.80 (d, 1 H, H-1), 5.05 (d, 1 H, H-2), 4.60 (d, 1 H, H-4), 4.0–4.29 (m, 3 H, H-5,6,6′), 1.9 (s, 3 H, NAc), 1.53, 1.43, 1.35, and 1.30 (4 s, each 3 H, 4 CH_3); ^{13}C, sugar part: δ 102.9 (C-1,3), 81.2 (C-2), 78.0 (C-4), 74.5 (C-5), 68.2 (C-6), 25.1, 26.6, 27.0, and 27.5 (4 CH_3), 113.8 and 111.5 (2 CMe_2); oxadiazole ring: 163.5 (CO), 151.0 (C-5′), 102.9 (C-2′), 25.1 (CH_3), 132.2, 128.5, and 127.9 (C_6H_5).

Anal. Calc. for $C_{21}H_{26}N_2O_7$: C, 60.3; H, 6.3; N, 6.7. Found: C, 60.1; H, 6.2; N, 6.7.

3-Acetyl-2,3-dihydro-2,2-dimethyl-5-phenyl-1,3,4-oxadiazole (**9**). — Compound **9** had m.p. 58–59°; lit.[11] m.p. 49–50°. ^{13}C-N.m.r. data: δ 166.8 (CO), 153.5 (C-5), 131.1, 128.4, and 126.6 (C_6H_5), 100.2 (C-2), 22.2 (CH_3).

3-Acetyl-2,3-dihydro-2,5-diphenyl-1,3,4-oxadiazole (**10**). — Compound **10** had m.p. 87–88°; lit.[11] m.p. 92–94°. ^{13}C-N.m.r. data: δ 167.9 (CO), 155.9 (C-5), 131.6 , 129.9, 128.7, 127.0, 126.7 (2 C_6H_5), 92.3 (C-2), 21.4 (CH_3).

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