Carbohydrate Research
Elsevier Publishing Company, Amsterdam
Printed in Belgium

Note

Heterocyclic amino sugar derivatives
Part III*. Epimino and oxazolidinone derivatives of 2-amino-2-deoxy-D-allose

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(Received May 1st, 1969)

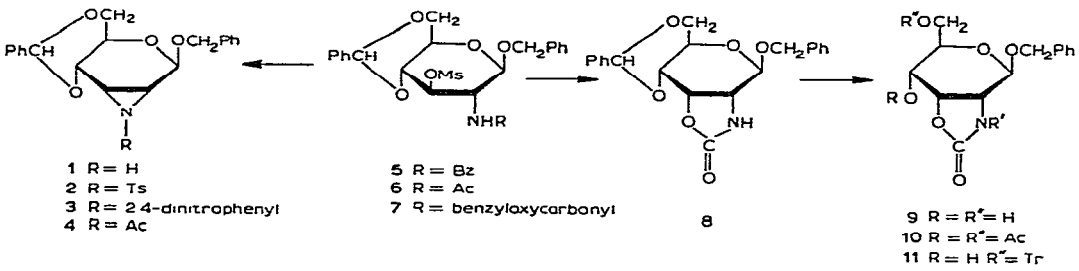
In a recent study of the reactions involving neighboring groups at C-2 and C-3 of 2-amino-2-deoxy-D-glucose and 2-amino-2-deoxy-D-altrose derivatives[1], the steric requirements and reaction conditions for tridentate neighboring groups were established in order to obtain 2,3-epimines or 5-membered heterocycles The diaxial *trans* disposition of the leaving group and of the neighboring group, the axial arrangement of the glycosidic groups, and the high basicity of the reagents are known to favor epimine formation[1]. Goodman has reviewed the influence of the conformation on these competitive reactions[2].

In the elimination of the mesyloxy group of benzyl 2-acylamino-4,6-*O*-benzylidene-2-deoxy-3-*O*-methylsulfonyl-β-D-glucopyranosides, only the basicity of the reagent was found to be of importance Sodium isopropoxide, which is more basic than is the previously used sodium ethoxide[3], was selected as the reagent. It had been used for the preparation of 3,4-epoxides of 2-amino-2-deoxy-D-galactose and -D-allose[3], and later[4] of 2,3-epimines by anchimerically assisted elimination of sulfonyloxy groups Irrespective of the substituent on the nitrogen atom, compounds **5**–**7** gave only benzyl 4,6-*O*-benzylidene-2,3-dideoxy-2,3-epimino-β-D-allopyranoside (**1**), although the leaving and participating groups had a diequatorial disposition, and no axial glycosidic group was hindering[1,5] formation of a 5-membered heterocycle Phenyl oxazoline, which could have resulted from **5**, and oxazolidinone, which could have resulted from **7**, were shown to be absent in the respective reaction mixtures The epimine **1** was characterized by *N*-tolylsulfonyl (**2**), *N*-(2,4-dinitrophenyl) (**3**), and *N*-acetyl (**4**) derivatives Attempts to cleave the epimino ring of the syrupy, but chromatographically pure, *N*-acetyl derivative **4** with ammonia gave only **1**.

When a weakly basic reagent, potassium acetate in aqueous 2-ethoxyethanol, was used, compounds **5**–**7** formed 5-membered heterocycles Whereas a stable phenyl oxazoline had resulted[6] from treatment of the *N*-benzoyl derivative **5**, the methyl

*For the previous paper in this series, see K Miyai and P H Gross, *J Org Chem*, 34 (1969) 1638
From the Ph D thesis, W D Rhoads, University of the Pacific, February, 1968

oxazoline, presumably resulting from the *N*-acetyl derivative **6**, was hydrolyzed under these conditions[6]. The *N*-(benzyloxycarbonyl) derivative **7** gave the oxazolidinone **8**, which was identical with an authentic sample[6] When the benzylidene group of **8** was split off, the resulting **9** could not be obtained in crystalline form The *N*-acetyl-di-*O*-acetyl derivative **10** and the 6-*O*-trityl derivative **11** were well characterized The latter compound is useful for disaccharide syntheses.



EXPERIMENTAL

Melting points were determined on a Thomas-Hoover melting-point apparatus model No 6404 H, and are uncorrected Optical rotations were measured with a Rudolph polarimeter, model No 956 Infrared spectra were recorded with a Perkin-Elmer Spectrophotometer, model 337, on potassium bromide pellets. All compounds were found to be homogeneous and different from their precursors by thin-layer chromatography on Silica Gel GF (Merck) with chloroform containing a sufficient portion of ethanol or hexane to produce R_F-values between 0 2 and 0 7 The spots were visualized by spraying with sulfuric acid (10–15%) in methanol, and heating at 120° The microanalyses were performed by Alfred Bernhardt of the Mikroanalytisches Laboratorium, Max-Planck-Institut fur Kohlenforschung, Muhlheim, Germany.

Benzyl 4,6-O-benzylidene-2,3-dideoxy-2,3-epimino-β-D-allopyranoside (**1**) — Sodium (0 23 g, 10 mmoles) was dissolved in 2-propanol (10 ml) and anhydrous dioxane (30 ml). Benzyl 2-acylamino-4,6-*O*-benzylidene-2-deoxy-3-*O*-methylsulfonyl-β-D-glucopyranoside (4 mmoles, acyl = benzoyl[7], acetyl[8], or benzyloxycarbonyl[9]) was added to this solution, and the mixture was heated for 18 h at reflux, cooled, and filtered The filtrate was evaporated *in vacuo*, and the residue was treated with water The precipitate was filtered off and recrystallized from methanol to give flaky crystals (0.8 g, 62%), m.p. 149°, $[\alpha]_D^{23}$ −5° (*c* 1.0, pyridine), ν_{max}^{KBr}. 3320 (epimine), 740 and 690 (Ph) cm^{-1}

Anal Calc. for $C_{20}H_{21}NO_4$ C, 70 80; H, 6 24; N, 4 15; O, 19.85. Found C, 70 93; H, 6 38; N, 4 20, O, 19 02.

The *N*-acetyl derivative, benzyl 2,3-acetylepimino-4,6-*O*-benzylidene-2,3-dideoxy-β-D-allopyranoside (**4**) was prepared from **1** (0 45 g) with pyridine (5 ml) and acetic anhydride (0 29 g) at 20°. After 3 days, the resulting solution was poured

onto ice, whereupon **4** precipitated as a syrup It was washed with ice-cold water, dried by azeotropic evaporation *in vacuo* with ethanol and toluene, and gave a syrup (0 37 g) which was found to be homogeneous and different from **1** on t l c.; ν_{max}^{KBr} 1710 (*N*-Ac) cm^{-1}. The N-H absorption at 3320 cm^{-1} shown by **1** was absent in the i r. spectrum of **4**

Benzyl 4,6-O-benzylidene-2,3-dideoxy-2,3-(p-tolylsulfonyl)epimino-β-D-allopyranoside (**2**). — A solution of **1** (0.5 g, 1 52 mmole) in anhydrous pyridine (10 ml) was treated with *p*-toluenesulfonyl chloride (0 35 g, 18 3 mmoles) at 10°. After 12 h at 0°, the mixture was poured onto ice, and the resulting precipitate was filtered off and recrystallized from a large volume of 2-propanol to give white needles (0.44 g, 60%), m.p 266–267°, $[\alpha]_D^{26}$ −17 5° (*c* 1.0, pyridine), ν_{max}^{KBr} 1330, 1160 (sulfonamide), 755, 730, and 710 (Ph) cm^{-1}.

Anal Calc. for $C_{27}H_{27}NO_6$ C, 65 70; H, 5 51; N, 2 84; O, 19 45 Found C, 65 58; H, 5.56; N, 2.94, O, 19.68

Benzyl 4,6-O-benzylidene-2,3-dideoxy-2,3-(2,4-dinitrophenyl)epimino-β-D-allopyranoside (**3**) — A mixture of **1** (0 5 g, 1.5 mmole), sodium hydrogen carbonate (1 g), 1-fluoro-2,4-dinitrobenzene (0.3 g, 1 8 mmole), and *N,N*-dimethylformamide (7 5 ml) was stirred for 22 h at 25° Ice–water was added, and the resulting precipitate was filtered off It was recrystallized from 2-propanol to give light-yellow crystals (0 39 g, 51%); m.p 72–74°, $[\alpha]_D^{23}$ −271° (*c* 1.0, pyridine), ν_{max}^{KBr} 1600, 1525, 835 (dinitrophenyl), 1340 (Ph-N), and 700 (Ph) cm^{-1}

Anal. Calc for $C_{26}H_{23}N_3O_8$: C, 61.78, H, 4.59, N, 8.31; O, 25 32 Found C, 61 54, H, 4 95, N, 8 22; O, 25 44

Benzyl 4',6'-O-benzylidene-2'-deoxy-β-D-allopyranosido[2',3' 4,5]-2-oxazolidinone (**8**) — Benzyl 4,6-*O*-benzylidene-2-(benzyloxycarbonyl)amido-2-deoxy-3-*O*-methylsulfonyl-β-D-allopyranoside (**7**) (3 0 g, 54 mmoles) and potassium acetate (3 g) in 2-ethoxy-ethanol (90 ml) containing 5% of water was heated for 5 days under reflux The reaction mixture was kept 24 h at 0° and filtered The filtrate was evaporated *in vacuo*, and the syrupy residue was treated with excess water. The tan crystals which formed were collected, washed with water, dried, and recrystallized twice from absolute ethanol to give 0 9 g (43%) of long, white needles, m p. 205–206°, $[\alpha]_D^{25}$ +13° (*c* 1.0, pyridine), ν_{max}^{KBr} 3300, 1750 (oxazolidinone), no amide II absorption, and 700 (Ph) cm^{-1} The identity with authentic material[6] was established by comparison of the i r spectra (identical), mixed m p. 206°, and identical mobility on t l c

Benzyl 4',6'-di-O-acetyl-2'-deoxy-β-D-allopyranosido[2',3'·4,5]-1-acetyl-2-oxazolidinone (**10**) — To a solution of **8** (0 6 g, 1 6 mmole) in glacial acetic acid (22 ml), water (12 ml) was added dropwise during 50 min at 80°. The solvents were removed *in vacuo* and then by coevaporation with ethanol and toluene The residual syrup, presumably benzyl-2'-deoxy-β-D-allopyranosido[2',3' 4,5]-2-oxazolidinone **9** was found to be different from **10** and homogeneous on t l c It was dissolved in pyridine (5 ml), treated with acetic anhydride (4 3 g, 42 mmoles) for 4 days at 20°, and poured onto ice The syrupy precipitate was treated with water, dried azeotropically with ethanol and toluene, and recrystallized from 2-propanol to give white flakes (0 21 g,

32%), m p. 89–91°, $[\alpha]_D^{23}$ +39° (*c* 1.0, pyridine); ν_{max}^{KBr} 1785 (*O*-Ac), 1740 (oxazolidinone), 1695 (*N*-Ac), and 705 (Ph) cm^{-1}.

Anal. Calc for $C_{20}H_{23}NO_9$ C, 57.00, H, 5.50; N, 3 33; O, 34 17. Found C, 57.09; H, 5 58, N, 3.16, O, 34 53.

Benzyl 2'-deoxy-6-O-triphenylmethyl-β-D-allopyranosido[2',3' 4,5]-2-oxazolidinone (**11**) — A solution of **9**, prepared from **8** (0 6 g) as above, in pyridine (2 ml) was shaken with chlorotriphenylmethane for 24 h at 25°. The mixture was poured into ice–water, and the precipitate was collected, dried, and recrystallized from a mixture of toluene, ether, and hexane to give white crystals (0 2 g, 24%), m p. 215–217°, $[\alpha]_D^{22}$ −9° (*c* 1 0, pyridine); ν_{max}^{KBr} 3400, 1760 (oxazolidinone), and 705 (Ph) cm^{-1}.

Anal. Calc. for $C_{33}H_{31}NO_6$ C, 73 72, H, 5 81, N, 2 61; O, 17 86 Found C, 73 88, H, 5 81, N, 2 80, O, 17 93

ACKNOWLEDGMENTS

Helpful discussions with Dr H K Zimmerman are acknowledged This work was supported, in part, by a grant (GP-4587) from the National Science Foundation

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