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UDC 547.455.07

Studies on the Fischer's *Glucal-hydrobromid-diacetat* and *Glucal-hydrobromid-triacetat*

In the year 1920, Fischer, *et al.*[1] recorded that 3,4,6-tri-O-acetyl-D-glucal (I) and hydrogen bromide in acetic acid gave a crystalline *Glucal-hydrobromid-diacetat*, $C_{10}H_{15}O_6Br$, m.p. 99~100°, $[\alpha]_D^{17}$ +39.9°(3 min.) → +34.1°(90 hour) (EtOH), which on reacetylation yielded a *Glucal-hydrobromid-triacetat*, $C_{12}H_{17}O_7Br$, m.p. 82~85°, $[\alpha]_D^{19}$ +54.4°(tetrachloroethane). Repetition of the work by Davoll and Lythgoe[2] yielded a sirup which decomposed in a way suggesting the presence of 1-bromo-1,2-dideoxy-D-glucose derivative. Since then, numerous effort to elucidate the Fischer's compounds has been envisaged up to this time. However, the structure and the configuration of these compounds have not yet been clarified.[3]

In the course of the progressive studies on D-glucal from our laboratory,[4] the authors were able to prepare two crystalline compounds having the same physical constants and properties with that Fischer described, which would presumably be the same compounds. In this communication, we dealt with the preparative method and the structural assignment of the compounds.

To a cold glacial acetic acid (50 ml.), previously saturated with dry hydrogen bromide at 0°, was added I (10 g.) and left to stand for 5 hour at 0°. After addition of chloroform, the mixture was washed with ice-water and ice-cold sodium bicarbonate solution. The organic layer was dried over sodium sulfate, filtered, and the filtrate evaporated *in vacuo* to give a pale yellow sirup. Without an interval of time, freshly prepared silver carbonate (10 g.) and aqueous acetone (56 ml. of acetone and 24 ml. of water) were added, then the mixture was stirred for 1 hour at room temperature. The filtrate was concentrated *in vacuo* to give a sirup which desiccated completely in a vacuum desiccator for 3 days. The residue was induced to crystals (II) (9 g.), m.p. 79~80°, $[\alpha]_D^{20}$ +57° (10 min.) → +46°(20 hour) ($CHCl_3$), from benzene-petr. ether, which showed two spots by a thin-layer chromatography. Benzene solution of II (2.5 g.) was absorbed on a silica gel column (*Kieselgel* 7734, E. Merck AG. Darmstadt, Germany) (50 g.) and eluated with benzene-ether (4:1, v/v). From the forthcoming eluate, crystals (III) (1.1 g.), m.p. 98~99°, $[\alpha]_D^{22}$ +40.5°(10 min.) → +34.5°(17 hour) (c=1, EtOH) were obtained after evaporation of the solvent, followed by recrystallization from benzene-petr. ether. IR λ_{max}^{Nujol} cm^{-1}: 3450 (OH), 1750 (OAc). The product reduced hot Fehling solution and it was positive towards the Beilstein's bromine test, along with the Dische test for 2-deoxysugars. *Anal.* Calcd. for $C_{10}H_{15}O_6Br$: C, 38.60; H, 4.85; Br, 25.69. Found: C, 38.63; H, 4.82; Br, 25.86.

From the second fraction of the chromatography, another crystals (IV) (1 g.), m.p. 93~95°, $[\alpha]_D^{20}$ +86°(10 min.) → +77°(16 hour) (c=1, EtOH) were separated which were free from bromine. *Anal.* Calcd. for $C_{12}H_{18}O_8$: C, 49.65; H, 6.25. Found: C, 49.73; H, 6.31. Acetylation of IV with acetic anhydride in pyridine afforded an authentic 2-deoxy-1,3,4,6-tetra-O-acetyl-α-D-glucopyranose,[5] m.p. 109~110°, $[\alpha]_D^{20}$ +108° (c=0.5, $CHCl_3$). Consequently, IV was assigned to be 2-deoxy-3,4,6-tri-O-acetyl-α-D-glucopyranose.

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1) E. Fischer, M. Bergmann, H. Schotte: Ber., **53**, 509 (1920).
2) J. Davoll, B. Lythgoe: J. Chem. Soc., **1949**, 2526.
3) B. Helferich: "Advances in Carbohydrate Chemistry" Vol. 7, p. 218 (1952). Academic Press, New York and London; W.G. Overend, M. Stacey: *Ibid.*, Vol. 8, p. 72 (1953); R.J. Ferrier: *Ibid.*, Vol. 20, p. 83 (1965).
4) M. Akagi, S. Tejima, H. Nakamura: Yakugaku Zasshi, **82**, 1337 (1962); *Idem.*: This Bulletin, **12**, 1302 (1964); T. Maki, H. Nakamura, S. Tejima, M. Akagi: *Ibid.*, **13**, 764 (1965).
5) W.A. Bonner: J. Org. Chem., **26**, 908 (1961).

Acetylation of III with acetic anhydride in pyridine, followed by recrystallization from ethanol, gave acetate (V), m.p. 82°, $[\alpha]_D^{20}$ +58°(c=1, $CHCl_3$). NMR at 60 Mc. (τ) ($CDCl_3$): 3.90 (anomeric H, triplet, J=2.5 c.p.s.), 7.45 (2H at C_2, multiplet), 7.86 ($2CH_3CO$), 7.90 (CH_3CO). *Anal.* Calcd. for $C_{12}H_{17}O_7Br$: C, 40.81; H, 4.85; Br, 22.63. Found: C, 41.01; H, 4.96; Br, 22.72.

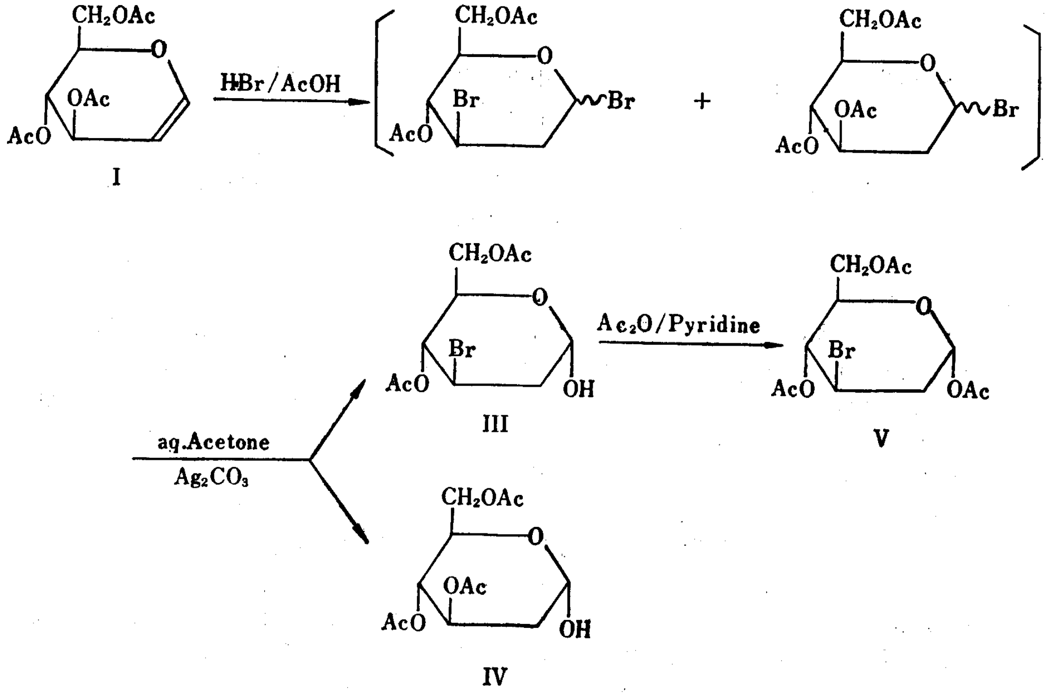

Chart 1.

The product (V) was also obtainable *via* another route mentioned below. Treatment of crystalline 2,3-dideoxy-3-bromo-4-O-acetyl-6-O-tosyl-α-D-glucopyranosyl bromide (VI) which was reported in the preceding paper by us,[6] in aqueous acetone under the presence of silver carbonate afforded 2,3-dideoxy-3-bromo-4-O-acetyl-6-O-tosyl-D-glucopyranose (VII), m.p. 128~131°, $[\alpha]_D^{20}$ +46°(c=1, acetone). *Anal.* Calcd. for $C_{15}H_{19}O_7SBr$: C, 42.56; H, 4.52; S, 7.58; Br, 18.88. Found: C, 42.46; H, 4.49; S, 7.66; Br,

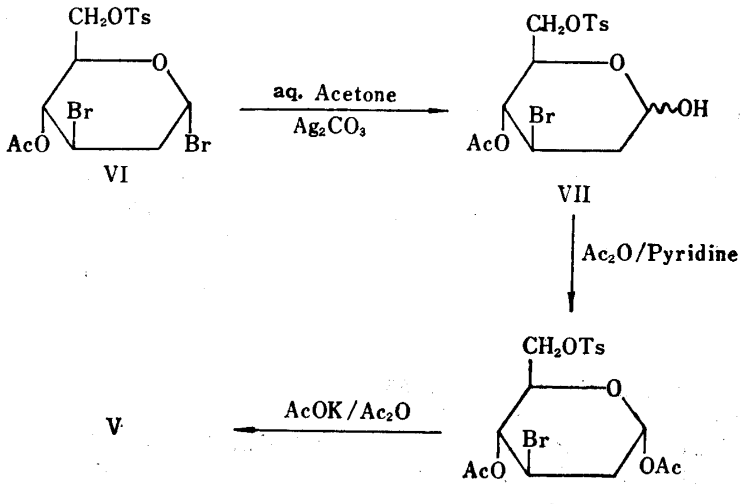

Chart 2.

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6) T. Maki, S. Tejima: This Bulletin, in press.

18.64. Acetylation of Ⅶ with acetic anhydride in pyridine afforded 2,3-dideoxy-3-bromo-1,4-di-O-acetyl-6-O-tosyl-α-D-glucopyranose (Ⅷ), m.p. 104.5~105.5°, $[\alpha]_D^{20}$ +60° (c=0.5, $CHCl_3$). *Anal.* Calcd. for $C_{17}H_{21}O_8SBr$: C, 43.88; H, 4.55. Found : C, 43.96; H, 4.59. Reflux of Ⅷ with potassium acetate in acetic anhydride for 1 hour gave crystals, m.p. 82°, undepressed on admixture of V, which were indistinguishable by IR with that of V.

Conclusively, the authors were able to establish an easy preparative method of compounds having the same properties with the Fischer's *Glucal-hydrobromid-diacetat* and *Triacetat*. The structures of these compounds (Ⅲ and V) were assigned to be 2,3-dideoxy-3-bromo-4,6-di-O-acetyl-α-D-glucopyranose and 2,3-dideoxy-3-bromo-1,4,6-tri-O-acetyl-α-D-glucopyranose, respectively.

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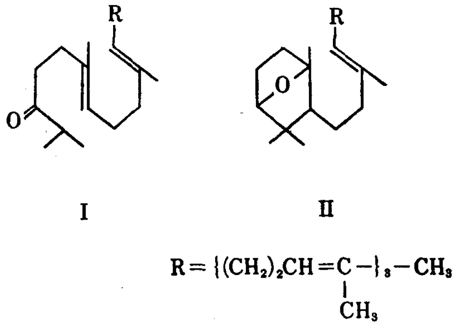
Acid-catalyzed Cyclization of Squalene Oxide[*1]

Recent report[1] on the cyclization of squalene 2,3-oxide with stannic chloride in benzene solution by van Tamelen prompted us to report our results on the cyclization of the same epoxide with boron trifluoride-ether in benzene.

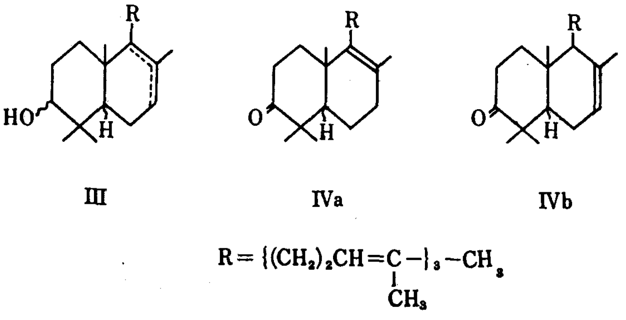
Squalene 2,3-oxide[2] in water-saturated benzene solution (0.1*N*) was treated with a catalytic amounts of boron trifluoride etherate for 15 hours. The reaction mixture was separated by silica-gel chromatography into three compounds, A, B and C with 9, 12 and 50% yield respectively. All of these compounds have the same molecular formula of $C_{30}H_{50}O$ (m/e 426, mol. w. 426.70).

Structure I and Ⅱ were deduced to the compounds A and B from the following spectroscopic evidences respectively.



$$R=\{(CH_2)_2CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-\}_3-CH_3$$

Chart 1.



$$R=\{(CH_2)_2CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-\}_3-CH_3$$

Chart 2.

[*1] From a thesis submitted to the undergraduate School of the Tohoku University in partial fulfillment of the requirement for the B. Sc. degree (1966, 3).

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2) E. E. van Tamelen, T. J. Curphey : Tetrahedron Letters, No. 3, 121 (1962).