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ADDITION REACTIONS OF GLYCALS. II. (1)

THE FREE-RADICAL ADDITION OF THIOLACETIC ACID TO D-GLUCAL TRIACETATE

Kikuo Igarashi and Tsunetoshi Honma

Shionogi Research Laboratory, Shionogi & Co., Ltd., Fukushima-ku, Osaka, Japan

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Addition reactions of D-glycals via ionic process have been investigated rather extensively so far (2) but there is very few report concerning the free-radical addition of D-glycal. We wish to report herein the free-radical addition of thiolacetic acid to D-glucal triacetate.

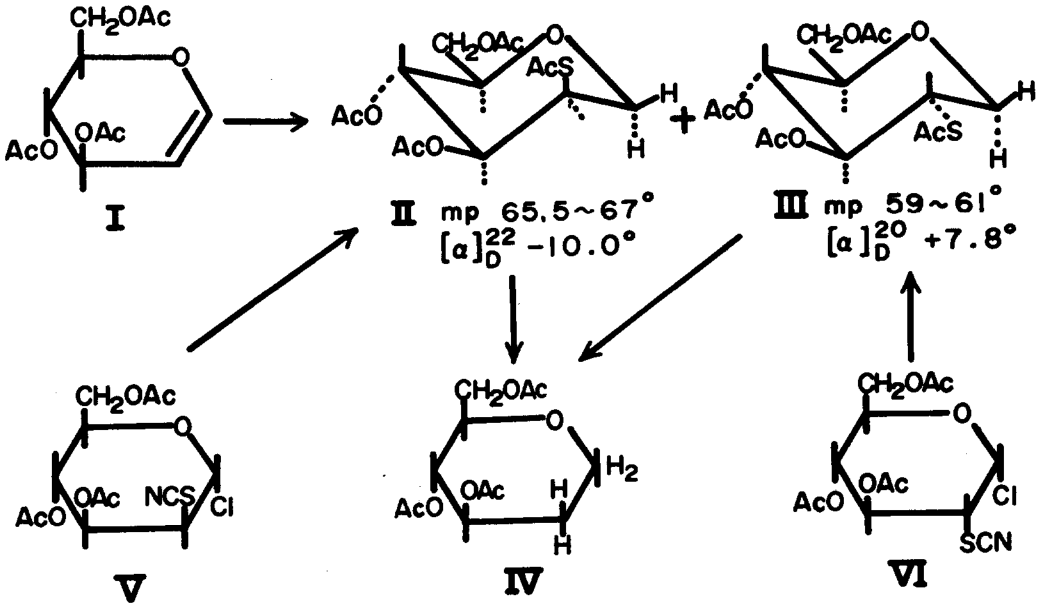
It is well known that cumene hydroperoxide (CHP) with or without ferrous sulfate initiates the free-radical addition of thiol to olefin (3,4) and that oxygen also initiates the addition reaction (5). The addition of thiolacetic acid to D-glucal triacetate was persued with or without these reagents inducing the free-radical reaction. The results are summarized in Table I. Judging from the results that the reaction occurred only in the use of the reagents, the reaction might proceed via radical process.

The products were isolated by a preparative thin layer chromatography and the product ratios were

TABLE I

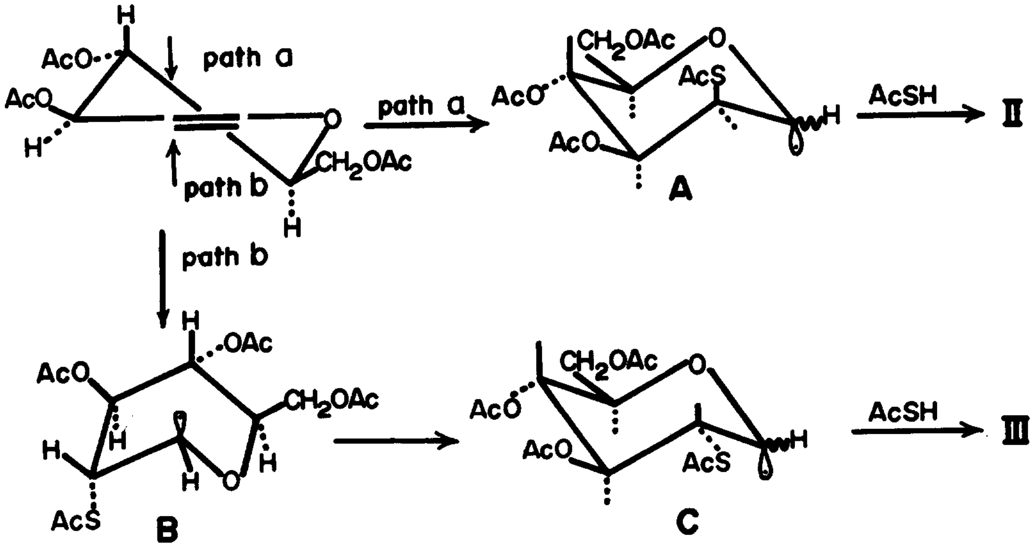
Molar[a] ratio	CHP[b]	$FeSO_4$	Time (hr)	Atmosphere	Condition[c]	Yields (%) of II	III
38	-	-	24	argon	in the dark[d] or in the light[e]	-	-
38	0.15	0.14	2/3	air	in the light[e]	61.3[f]	25.3
38	0.147	-	1/2	argon	in the light[e]	68.3	28.2
38	-	-	24	oxygen	in the light[e]	29.6(7)	13.4
38	-	-	24	oxygen	in the dark[d]	45.5(7)	21.1

[a] AcSH : I.
[b] CHP was purified through the sodium salt and vacuum distillation of the freed CHP. The values shown for CHP and ferrous sulfate are molar equivalent to I.
[c] At room temperature.
[d] The reaction was performed in a foil-covered flask.
[e] The reaction was performed in a flask without special irradiation.
[f] Yields of products isolated by preparative thin layer chromatography.



II mp 65.5~67° $[\alpha]_D^{22}$ −10.0°

III mp 59~61° $[\alpha]_D^{20}$ +7.8°



determined from the result of gas-liquid chromatography (6) using methyl 2,3,4,6-tetra-O-acetyl-α-D-glucopyranoside as an internal standard.

TABLE II

Molar[a] ratio	Product distribution II	III
1.5[b]	74.8	25.2
4.9	72.9	27.1
9.85	71.4	28.6
18.4	70.9	29.1
38	70.8	29.2

[a] AcSH : I. Purified CHP (0.147 molar equivalent for I) is used as an initiator. Reaction time is 30 min at room temperature in the light.

[b] I does not dissolve in thioacetic acid below 1.5 of molar ratio.

Satisfactory elemental analyses have been obtained for both products. Both compounds did not reduce the Fehling's solution and gave crystalline 3,4,6-tri-O-acetyl-1,5-anhydro-2-deoxy-D-arabinohexitol (D-hydroglucal triacetate)(8)(IV) by reduction with Raney nickel. Compounds II and III were obtained from 3,4,6-tri-O-acetyl-2-deoxy-2-thiocyanato-α-D-mannopyranosyl chloride (V) and -α-D-glucopyranosyl chloride (VI) (1) by lithium aluminum hydride reduction followed by acetylation, respectively. From these results II and III were proved to be 3,4,6-tri-O-acetyl-2-S-acetyl-1,5-anhydro-2-thio-D-mannitol and -D-glucitol, respectively.

Changing the initial concentrations of the reactants had almost no effect on the ratio of the products formed in the reactions (see Table II).

Although the free-radical additions of thiolacetic acid to cyclohexene derivatives were not stereospecific, stereoselective trans-diaxial addition has been observed (9). It is also shown that the stabilization of an alkoxy radical by resonance in the radical involved $(-\dot{C}H-O- \rightarrow -\underset{\ominus}{C}H=\underset{\oplus}{\dot{O}}-)$ is small (10, 11). In the present study, II (SAc group in an axial position) was obtained in about 70% yield and III (SAc group in an equatorial position) in about 30% yield. Attack of the AcS· radical from the "front" side (path a) of D-glucal triacetate yields an intermediate, which has a half-chair conformation, without remarkable steric hindrance. The intermediate can form a chain reaction intermediate A, which has a chair conformation, without serious change of the conformation. On the other hand, attack of the AcS· radical from the "rear" side (path b) of D-glucal triacetate yields an intermediate B, which has a twist-boat conformation. The radical B has to isomerize to a chain reaction intermediate C, which has a chair conformation. It is well known that the half-chair conformation is more stable than the twist-boat conformation. Radicals A and C react with thiolacetic acid to give II and III, respectively. This representation offers an explanation for the preferable formation of II over III.

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6. Gas-liquid chromatographies were performed on a 7.4 ft. x 0.12 in. stainless column packed 1.5% diethylene glycol succinate on Gaschrom P.
7. In this case several by-products are obtained, and their structures will be reported in the full article.
8. This compound has been reported as a sirup, $[\alpha]^{23}_{D}$ +34.5° (EtOH), by E. Fischer (*Ber.*, **47**, 196 (1914) but we got it as a crystalline form, m.p. 41-42.5°, $[\alpha]^{24}_{D}$ +34.5° (EtOH).
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