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Note

Desulphuration of carbohydrate thio-orthoesters with Raney nickel*

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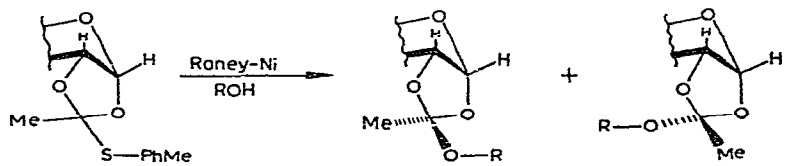
Peracetylated carbohydrate thio-orthoesters[1] of the type **1** could serve as precursors to otherwise inaccessible pyranosidic 1,2-cyclic acetals[2]. However, attempted desulphuration of the *exo*-thio-orthoester derived from α-D-glucopyranose, with Raney nickel in ethanol, gave the corresponding ethyl orthoester[3] in high yield. This unexpected result prompted further investigation, especially as some controversy exists regarding the mechanism[4] of desulphuration with Raney nickel.



1 **2** *(exo)* **3** *(endo)*

Peracetylated thio-orthoesters (**1**) derived from α-D-glucopyranose, methyl D-glucopyranuronate, and α-D-lactose, when treated with Raney nickel in ethanol, gave the ethyl orthoesters in high yield, indicating that the reaction is fairly general (see Table I). When propan-2-ol was used as solvent, the D-glucose thio-orthoester derivative gave the corresponding isopropyl orthoester. However, with *tert*-butyl alcohol, no orthoester was formed and 2,3,4,6-tetra-*O*-acetyl-D-glucopyranose was the main product, probably formed by reaction of the thio-orthoester with residual water. A similar result was obtained when cyclohexanol–toluene was used as solvent. Products other than orthoesters were also formed (t.l.c.). Repeated washing of the Raney nickel with dry solvent apparently does not give a water-free product, and drying by azeotropic distillation made it insufficiently active for complete desulphuration. The desulphuration reaction is therefore unsuitable for the preparation of orthoesters with complex alcohols (*e.g.*, protected sugars) for further synthesis of glycosides[5].

*Carbohydrate Thio-orthoesters: Part II. For Part I, see Ref. 1.

TABLE I

DATA ON ORTHOESTERS (2 AND 3) FORMED ON DESULPHURATION OF THIO-ORTHOESTERS (1)

Configuration of thio-orthoester (parent sugar)	*ROH*	*Peracetylated orthoester*								
		Yield (%)	*Product composition*[a] (exo/endo)	*Chemical shifts*[b] (δ) *orthoester CMe*		*Relative intensity* (%) *of significant mass-spectral peaks*				
				exo	endo	M^+	$(M-15)^+$	$(M-45)^+$	$(M-59)^+$	*Base peak*
exo (α-D-glucopyranose)	EtOH	88	34/66	1.71	1.56		1	20	3	169
	i-PrOH	89	42/58	1.72	1.57		<1		32	169
endo (α-D-glucopyranose)	EtOH	98[c]	78/22	1.71	1.56		2	18	4	169
exo (methyl α-D-glucopyranuronate)	EtOH	97	30/70	1.75	1.57	<1	1	12	8	155
exo (α-D-lactose)	EtOH	87	36/64	1.73	1.56		<1	6	<1	169

[a]Determined by n.m.r. spectroscopy. [b]$CDCl_3$ (internal Me_4Si). [c]*exo*-Ethyl orthoester was isolated and had m.p. 96–97°, $[\alpha]_D^{25}$ +30.5° (*c* 0.5, chloroform); lit.[6] m.p. 97–97.5°, $[\alpha]_D$ +31° (chloroform).

A mixture of *exo* (2) and *endo* orthoesters (3) was obtained in the successful desulphuration reactions. The relative amounts of the *exo* and *endo* products were dependent on the configuration of the thio-orthoester, as is shown in Table I. Thus, the *exo*-thio-orthoesters **1** gave more of the less-stable *endo*-orthoester **3**, and the *endo*-thio-orthoester gave more of the stable *exo* product. Thus, the reaction probably proceeds *via* ion pairs (configurationally related to the starting thio-orthoester) that become solvated from the side opposite to the sulphur anion more rapidly than the ions can separate. Alternatively, the reaction might be regarded as having a high degree of S_N2 character.

EXPERIMENTAL

General synthetic procedure. — The thio-orthoester (200 mg) was dissolved in the appropriate solvent (5 ml), and Raney nickel (Merck hydrogenation catalyst, ~2 g, washed several times with the same solvent) was added (gas evolution). When the reaction was complete (usually <10 min; t.l.c., silica gel, ethyl acetate–light petroleum), the reaction mixture was filtered through Celite, and concentrated to give almost pure (n.m.r. spectroscopy) orthoester as a colourless oil. Yields, *exo*/*endo* compositions, and n.m.r. and mass-spectral data are shown in Table I. The chemical shifts and coupling constants agreed with those for the D-glucose ethyl and isopropyl orthoester derivatives previously reported[3].

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REFERENCES

1 G. MAGNUSSON, *J. Org. Chem.*, 41 (1976) 4110–4112.
2 W. E. DICK, JR., D. WEISLEDER, AND J. E. HODGE, *Carbohydr. Res.*, 23 (1972) 229–242.
3 R. U. LEMIEUX AND A. R. MORGAN, *Can. J. Chem.*, 43 (1965) 2199–2204.
4 G. R. PETTIT AND E. E. VAN TAMELEN, *Org. React.*, 12 (1962) 359–529.
5 N. K. KOCHETKOV, A. F. BOCHKOV, T. A. SOKOLOVSKAYA, AND V. J. SNYATKOVA, *Carbohydr. Res.*, 16 (1971) 17–27.
6 R. U. LEMIEUX AND J. D. T. CIPERA, *Can. J. Chem.*, 34 (1956) 906–910.