Note

Acetylated aldosyl chlorides by reaction of aldose peracetates with zinc chloride-thionyl chloride *

L P EGAN, T G SQUIRES, AND J R VERCELLOTTI** Department of Chemistry, University of Tennessee, Knowville, Tennessee 37916 (U S A) (Received November 24th, 1969, in revised form, January 23rd, 1970)

We report a new procedure for the synthesis of aldosyl chlorides and aldosyl chlorides of oligosaccharides from the corresponding peracetylated sugars by the use of zinc chloride-thionyl chloride Previously 2,3,4,6-tetra-O-benzyl- α -D-glucopyranosyl chloride was prepared by use of this reagent¹.

The reactions proceeded smoothly in all cases, usually reaching completion in about 2 h The crude yields of crystalline product were generally 60–85% and by t l c were adequately pure for most purposes without further recrystallization (see Table I)

2,3,4,6-Tetra-O-acetyl- α -D-galactopyranosyl chloride proved difficult to purify, requiring at least three careful recrystallizations from ethyl ether-petroleum ether to afford a product having physical properties similar to those in the literature². Micro-analysis of this compound gave the calculated values, and the m p agreed with the value (74–75°) given (see Table I) by Fischer and Armstrong³, but the data did not agree with either the melting point (82°) nor the rotation given by Skraup and Kremann⁴. For this chloride Korytnyk and Mills⁷ reported m p 78–79° and [α]²⁵ +175 1° The optical rotation of +195 5° reported in Table I is the value obtained for several preparations after repeated recrystallizations

Chemical-shift data for the first crop of crystalline product from reaction mixtures showed in each case that only the α -D anomer was formed during chlorination, and the peracetylated starting material disappeared completely All structural assignments in the present investigation were confirmed by n m r spectroscopy. Chemical shifts and coupling constants for the acetylated glycosyl chlorides were in accord with values previously reported

Table I compares results from the chlorination of 1,2,3,4,6-penta-O-acetyl- α -D-glucopyranose and 1,2,3,4,6-penta-O-acetyl- β -D-glucopyranose A similar yield of the corresponding α -D chloride was formed from both anomeric acetates The

^{*}This study was supported by the Agricultural Research Service, U S Department of Agriculture, Grant 12-14-100-9208 (71), administered by the Northern Utilization Research and Development Division, Peoria, Illinois 61640, U S A

^{**}To whom inquiries should be directed

Anomeric	Producta	Crude	TIC	M p ^b (degree	ss)	[a] ²⁰⁻²⁵ (de ₁	grees, CHCl ₃)	Ref
of starting peracetate		yieiu~ (%)	solvent	Found	Lit	Found	<i>Lit</i>	
α-D	2,3,4,6-Tetra-O-acetyl-α D- glucopyranosyl chloride	85	æ	72-73 5	76	+ 164	+166	10
β-D	2,3,4,6-Tetra-O-acetyl-& D- glucopyranosyl chlorude	68	æ	70 5–72	76	+ 165	+ 166	10
β-D	2,3,4,6-Tetra-O-acctyl α D- mannopyranosyl chlorade	80	в	77-78	81	+ 89	+906	11
<i>д-у</i>	2,3,4,6-Tetra-O-acetyl-x D- galactopyranosyl chloride	68	А	75-76	76	+1955	+212.3 +177 5	4 v
<i>д-</i> р	2,3,4-Trı-O-acctyl-∞-D- xylopyranosyl chlorıde	81	B	100-101	105	+ 169 8 + 205 (C ₆ H ₆)	+171 2	10
β-D	Methyl 2,3,4-trı- <i>O</i> -acetyl- 1-chloro-1-deoxy-&-D glucuronate	66	B	100 5-101 5	99-100 98 5-100	+ 160 7 + 200 3 (C ₃ H ₃)	+1687 +162	12 13
q-x	Hepta-O-acetyl-&-lactosyl chloride	78 (CHCl ₃ - Et ₂ O)	U	118-120 (CHCl ₃ - Et ₂ O)	120-121	+842	+ 83 9	Ξ

Carbohyd Res, 14 (1970) 263-266

TABLE I

otherwise noted 'See introduction to experimental section

anomeric configurations of the sugar peracetates used (Table I) did not affect the yield of α -D glycosyl chlorides produced This observation differs from the experience of other investigators^{2,5} who used titanium tetrachloride.

An attempt was made to prepare 2,3 5,6-di-O-isopropylidene- α -D-mannofuranosyl chloride from 2,3 5,6-di-O-isopropylidene- α -D-mannofuranose⁶ by using zinc chloride-thionyl chloride N m r spectroscopy indicated the loss of one isopropylidene group and the formation of the glycosyl halide⁷ 1,2,3,4,6-Penta-O-benzoyl- β -Dglucopyranose, when treated with zinc chloride-thionyl chloride, gave only crystalline starting material Other halogenating agents are better suited for the formation of perbenzoylated glycosyl chlorides⁸

These reactions of zinc chloride-thionyl chloride apparently proceed by a mechanism similar to the action of other Lewis acids and halogenating agents with sugar peracetates^{2,5,9}

EXPERIMENTAL

General — Ascending t.1 c was performed on Silica Gel G (E Merck Co, Darmstadt, Germany, activated for 1 h at 110°) Location of zones was achieved by charring after spraying with a 35% solution of ammonium sulfate. Solvents for t 1 c were 3 1 petroleum ether (b p $30-60^\circ$)-ethyl acetate (solvent A); 2 1 petroleum ether (b p $30-60^\circ$)-ethyl acetate (solvent B), and 1 1 petroleum ether (b p $30-60^\circ$)-ethyl acetate (solvent C) Microanalyses were performed by Galbraith Laboratories, Knoxville, Tennessee 37921, U S A

The crude, crystalline products (Table I) showed only traces of starting material and inorganic salts by t l c After one recrystallization from ether-petroleum ether (b p $30-60^{\circ}$) all products were chromatographically homogeneous Physical data recorded in Table I are for substances recrystallized several times until constant values were obtained.

General procedure for preparation of acetylated glycosyl chlorides — Preparations of all acetylated glycosyl chlorides were carried out in the same manner as here described for 2,3,4-tri-O-acetyl- α -D-xylopyranosyl chloride To a solution of tetra-Oacetyl- β -D-xylose (5 00 g, 15 8 mmoles) in benzene (40 ml) was added thionyl chloride (2 3 ml, 32 mmoles) followed by freshly fused zinc chloride (0 80 g, 5 9 mmoles) The mixture was stirred at room temperature T l c (solvent B) showed conversion of tetra-O-acetyl- β -D-xylose (R_F 0 32) into 2,3,4-tri-O-acetyl- α -D-xylopyranosyl chloride (R_F 0 59) within 2 h, whereupon the mixture was filtered by suction through Celite (2 cm) on a sintered-glass funnel The filtrate and benzene washings were evaporated to an oil, and then toluene (70 ml total) was evaporated three times at 65° from the oil to remove the last traces of thionyl chloride The resulting syrup was crystallized from ethyl ether-petroleum ether (b p 30-60°) to give 3 75 g (81%) of 2,3,4-tri-O-acetyl- α -D-xylopyranosyl chloride, m.p 89-96°, raised to 100-101° after 3 recrystallizations

REFERENCES

- I V D GROB, T G SQUIRES, AND J R VERCELLOTTI, Carbohyd Res, 10 (1969) 595
- 2 J STANĚK, M ČERNY, AND J PACÁK, The Monosaccharides, Academic Press, New York, 1963, p. 214
- 3 E FISCHER AND E F ARMSTRONG, Ber, 34 (1901) 2885
- 4 Z H SKRAUP AND R KREMANN, Monatsh Chem, 22 (1901) 375
- 5 W KORYTNYK AND J A MILLS, J Chem Soc, (1959) 636
- 6 J B LEE AND T J NOLAN, Tetrahedron, 23 (1967) 2789
- 7 L EGAN, V GROB, AND J R VERCELLOTTI Abstracts Papers Amer Chem Soc Meeting, 158 (1969) Carb 2
- 8 R K NESS, HEVITT G FLETCHER, JR, AND C S HUDSON, J Amer Chem Soc, 73 (1951) 959
- 9 P C DOOLAN AND P H GORE, Chern Commun, (1968) 1624
- 10 D H BRAUNS, J Amer Chem Soc, 47 (1925) 1280
- 11 E PASCU, Ber, 61 (1928) 1508
- 12 W F GOEBEL AND F H BABERS, J Biol Chem, 111 (1935) 347
- 13 W. D S BOWERING AND T E TIMELL, J Amer Chem Soc, 82 (1960) 2827

Carbohyd Res, 14 (1970) 263-266