CHEMISTRY LETTERS, pp. 861-862, 1982.

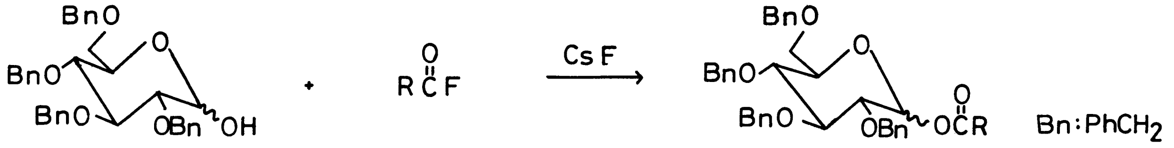
STEREOSELECTIVE SYNTHESIS OF 1-O-ACYL-D-GLUCOPYRANOSE FROM 1-HYDROXY SUGAR AND ACYL FLUORIDES BY THE PROMOTION OF CESIUM FLUORIDE

Shin-ichiro SHODA and Teruaki MUKAIYAMA
Department of Chemistry, Faculty of Science,
The University of Tokyo, Hongo, Bunkyo-ku, Tokyo 113

In the presence of cesium fluoride, the reaction of 2,3,4,6-tetra-O-benzyl-D-glucopyranose with acyl fluorides affords the corresponding glucosyl esters in good yields under essentially neutral condition. The α/β ratio of produced glucosyl esters is greatly affected by reaction conditions and predominant formations of each anomer is achieved by procedures described herein.

In the previous paper,[1)] we have shown that, in various acylation reactions, cesium fluoride is effectively employed as an accelerator and an acid captor in place of conventionally used tertiary amines. Consequently, various carboxylic acid derivatives having base sensitive functional groups can be successfully prepared under essentially neutral condition.

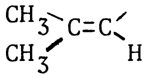
In this communication, we wish to report that cesium fluoride is effective for the stereoselective formation of α- and β-glucosyl esters starting from 2,3,4,6-tetra-O-benzyl-D-glucopyranose and acyl fluorides.[2)] The α/β ratio of glucosyl esters was greatly affected by changing the order of the addition of each reagent. Namely, β-glucosyl esters are predominantly obtained when acyl fluoride solution is added dropwise into the suspension of 1-hydroxy sugar and cesium fluoride over a period of 3 h, while α-anomer predominates when the reagents are mixed in the reverse order.



The following is a typical procedure for the synthesis of 1-O-benzoyl-2,3,4,6-tetra-O-benzyl-β-D-glucopyranose: To a stirred suspension of cesium fluoride (300 mg, 2.0 mmol) and 2,3,4,6-tetra-O-benzyl-D-glucopyranose (108 mg, 0.2 mmol) in dichloromethane (1 ml) was added benzoyl fluoride (37 mg, 0.3 mmol) in dichloromethane (4 ml) over a period of 3 h. Water was added to the reaction mixture which was subsequently extracted with dichloromethane. The organic layer was washed with water, dried over sodium sulfate and the solvent was removed under reduced pressure. The residue was subjected to column chromatography yielding

1-O-benzoyl-2,3,4,6-tetra-O-benzyl-D-glucopyranose (126 mg) in 98% yield (α/β=10/90). The corresponding α-anomer was obtained predominantly by adding the dichloromethane (2 ml) solution of 1-hydroxy sugar (0.2 mmol) to the suspension of acyl fluoride (0.3 mmol) and cesium fluoride (2.0 mmol) over a period of 10 minutes. As shown in Table, α- and β-glucosyl esters are obtained in high yields.

Table. Synthesis of Glucopyranosyl Ester

R	Condition	Yield (%)	α/β a)
Ph	A	98	10/90
$Ph(CH_2)_3$	A	quant	25/75
$PhCHC_2H_5$	A	quant	14/86
t-Bu	A	91	5/95
 $(CH_3)_2C=CH$	A	95	15/85 b)
Ph	B	90	75/25 c)
$Ph(CH_2)_3$	B	99	80/20 d)
$PhCHC_2H_5$	B	quant	80/20 e)

A: Acyl fluoride was added dropwise to 1-hydroxy sugar at room temperature over a period of 3 h.
B: 1-hydroxy sugar was added dropwise to acyl fluoride over a period of 10 min.
a) The ratio (α/β) was determined by the comparison of each anomeric proton resonance in NMR spectra.
b) No isomerization of the olefinic group was observed. When the reaction was carried out in the presence of triethylamine instead of cesium fluoride, isomerization of the olefinic group takes place.
c) r.t. d) 0°C e) Reaction was carried out in the presence of catalytic amount of 4-dimethylaminopyridine.

In this reaction, it is speculated that C-1 hydroxyl group is strongly activated by cesium fluoride through hydrogen bonding and observed stereoselectivity may be attributed to the presence or absence of internal chelation of the cesium ion to ring oxygen of glucose under the condition of A or B.

Recently, Pfeffer et al. reported the preparation of glucosyl ester from 1-hydroxy sugar and acyl chloride using n-butyl lithium as a base and α- and β-glucosyl esters are obtained stereoselectively by changing the reaction solvent.3) In comparison with the strongly basic condition mentioned above, the present method enables a stereoselective preparation of α- and β-glucosyl esters in good yields under essentially neutral condition by using cesium fluoride.

Further investigations regarding precise mechanism of this reaction are now in progress.

References

1) S. Shoda and T. Mukaiyama, Chem. Lett., 1980, 391. 2) Acyl fluorides were prepared according to a method of T. Mukaiyama and T. Tanaka, Chem. Lett., 1976, 303. When acyl chloride or acyl bromide is used in place of acyl fluoride, reaction begins after stirring the reaction mixture for several hours, and went to completion almost instantaneously.
3) P. E. Pfeffer, E. S. Rothman, and G. G. Moore, J. Org. Chem., 41, 2925 (1976). It should also be noted that Ogawa et al. have reported the stereoselective synthesis of β-glucosyl esters using tributylstannyl carboxylate or tributylstannyl alkoxide. T. Ogawa, M. Nozaki and M. Matsui, Carbohydr. Res., 60, C-7 (1978).

(Received April 1, 1982)