CHEMISTRY LETTERS, pp. 2335-2336, 1987.

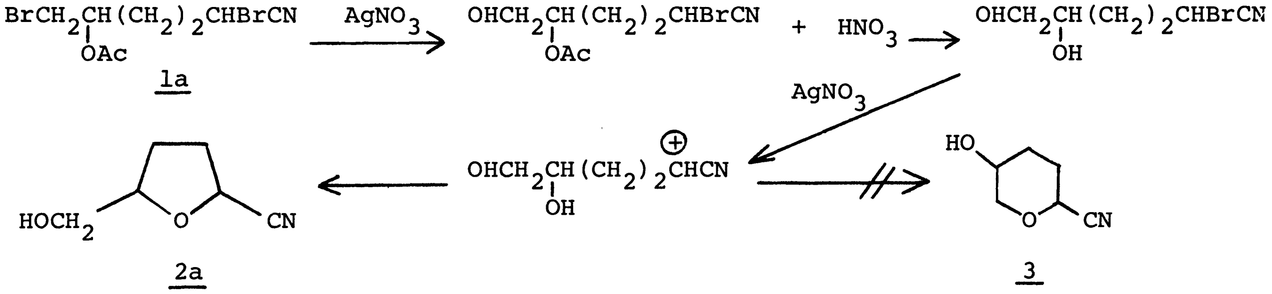
Preparation of Tetrahydrofurfuryl Alcohol Derivatives with Electron-Withdrawing Substituents from 4-Acetoxy-1,5-dibromopentane Derivatives by Treatment with Silver Nitrate

Michiharu MITANI,* Hiroshi TAKEUCHI, and Kikuhiko KOYAMA
Department of Synthetic Chemistry, Faculty of Engineering,
Shinshu University, Wakasato, Nagano 380

When 4-acetoxy-1,5-dibromopentane derivatives having the electron-withdrawing groups at the 1-position, which were obtained by Cu(I)-catalyzed photochemical addition of 2-acetoxy-1,3-dibromopropane to electron-deficient olefins, were subjected to treatment with silver nitrate, tetrahydrofurfuryl alcohol derivatives with the electron-withdrawing groups at the 5-position were obtained.

The tetrahydrofurfuryl alcohol derivatives are thought to be the interesting class of bioactive compounds as suggested by the potent AIDS drug activity of 2',3'-dideoxyribonucleosides[1)] and the herbicidal use of cyanotetrahydrofurfuryl derivatives.[2)] However, preparation of the tetrahydrofurfuryl alcohol derivatives with the electron-withdrawing substituents has been so far known of only a few examples containing cyanotetrahydrofurfuryl alcohol derivatives[2)] and hydroxymethyl-γ-butyrolactones.[3)] We wish to report here our results that various tetrahydrofurfuryl alcohol derivatives with the electron-withdrawing groups at the 5-position are derived by treatment with silver nitrate from 4-acetoxy-1,5-dibromopentane derivatives having the electron-withdrawing groups at the 1-position, which are readily prepared by Cu(I)-catalyzed photochemical addition of 2-acetoxy-1,3-dibromopropane to electron-deficient olefins.[4)]

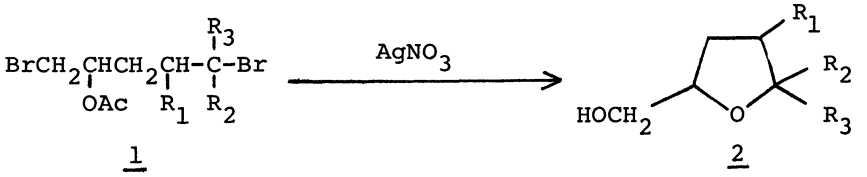
5-Acetoxy-2,6-dibromohexanenitrile (1a) (2 mmol) was subjected to thermoreaction with silver nitrate (5 mmol) in DMSO (12 ml)-H_2O (15 ml) at 110 °C for 1 h. After neutralization with aq. NaOH and filtration of precipitates, the majority of the solvent (DMSO and H_2O) was removed under reduced pressure. VPC analysis of the residue showed the presence of the only volatile product, which was isolated by silica-gel column-chromatography and was suggested to be 5-cyanotetrahydrofurfuryl alcohol (2a) or 2-cyano-5-hydroxytetrahydropyran (3) as its possible structure by ^1H and ^{13}C-NMR, IR, and mass spectra. However, possibility of 3 was excluded because its hydroxyl group was proved to be primary by ^1H-NMR spectra after its acetylation and thus it was assigned as 2a. As for the pathway to afford 2a from 1a in the presence of $AgNO_3$, it may be possibly assumed that the first equivalent of $AgNO_3$ transforms the primary bromomethyl group of 1a to the hydroxymethyl group with generation of HNO_3, which in turn catalyzes hydrolysis of the acetoxyl group to the hydroxyl group, and then the second equivalent of $AgNO_3$ abstracts bromide anion from the carbon bearing cyano group to generate a carbonium ion which undergoes an intramolecular nucleophilic attack by the internal hydroxyl group to afford 2a (Scheme 1). The control experiment that hydrolysis of n-butyl acetate was performed by thermoreaction in the presence of both components of AgNO$_3$ and bromomethylcyclohexane seems to support the assumed pathway to contain transformation of the acetoxyl group to the hydroxyl group as shown in Scheme 1.



Scheme 1.

Preparation of various tetrahydrofurfuryl alcohol derivatives is collected in Table 1. When the substrate with the alkoxycarbonyl group as the electron-withdrawing group, e.g. 1b, underwent heating for a longer time (e.g. 3 h), hydrolysis of that group occurred.

Table 1. Preparation of tetrahydrofurfuryl alcohol derivatives from 4-acetoxy-1,5-dibromopentane derivatives



	R_1	R_2	R_3	Yield of 2 / %
a	H	H	CN	72
b	H	H	COOMe	81
c	H	H	COMe	57$^{a)}$
d	H	H	CHO	40$^{a)}$
e	H	Me	CN	70
f	H	Me	COOMe	77
g	H	CH_2COOEt	COOEt	74
h	Me	H	CN	71
i	Me	H	COOMe	79
j	COOEt	H	COOEt	72

a) Dioxane-H_2O was used as the solvent to facilitate isolation of the product.

References

1) I. Saito, Yuki Gosei Kagaku Kyokai Shi, 44, 1022 (1986).

2) U. S. P. 4439225; Chem. Abstr., 101, 7026a (1984).

3) H. Marschall, J. Penninger, and P. Weyerstahl, Liebigs Ann. Chem., 1982, 49; S. A. Kazaryan, K. K. Lulukyan, M. G. Zalinyan, and M. T. Dangyan, Arm. Khim. Zh., 25, 777 (1972).

4) M. Mitani, I. Katoh, and K. Koyama, J. Am. Chem. Soc., 106, 3368 (1983).

(Received September 11, 1987)