Selective Deprotection of Propargyl Ethers Using Tetrathiomolybdate

V. M. Swamy, Palanichamy Ilankumaran and Srinivasan Chandrasekaran*
Department of Organic Chemistry, Indian Institute of Science, Bangalore, India

Received 6 January 1997

Dedicated to Professor E. J. Corey, an inspiring teacher and mentor whose contributions have greatly enriched the art of synthetic organic chemistry

Abstract: Benzyltriethylammonium tetrathiomolybdate, $[PhCH_2NEt_3]_2MoS_4$, **1** deprotects propargyl ethers of alcohols and phenols in a selective manner in high yields. Easily reducible groups like nitro, aldehyde, keto and allyl are not affected.

Masking of hydroxyl function is very important in organic synthesis since it interferes in several reactions.[1] This is achieved normally by converting it into esters or ethers of several kinds.[2] Ethers are preferred over esters because of their greater stability than the esters. In more complex systems like carbohydrates, selective cleavage of one ether in the presence of another is often needed to achieve the synthesis.[2] Even though several procedures are available to fulfil the job, still problems exist.

Recently we have shown that benzyltriethylammonium tetrathiomolybdate, $[PhCH_2NEt_3]_2MoS_4$, **1** can convert alkyl halides into disulfides[3] and it can mediate a very efficient reduction of azides[4] and thiocyanates.[5] It was also found that it can effect a highly selective deprotection of propargyl esters.[6] In extending this reaction further, it was of interest to study the reactivity of **1** towards propargyl ethers. On treatment of benzyl propargyl ether with **1**, (2 eq) in DMF at room temperature, a clean deprotection occurred to give benzyl alcohol as the only isolable product. This observation prompted us to study the reactivity of several substituted propargyl ethers towards **1** . The results are summarized in Table I.

Treatment of propargyl ethers **2** and **4** with tetrathiomolybdate **1**, gave the corresponding alcohols **3** and **5** respectively in good yields. The reactivity of propargyl ethers of phenols with **1** in CH_3CN was equally effective. Thus 4-t-butyl-1-propargyloxybenzene (**6**) gave 4-t-butyl phenol (**7**) under similar reaction conditions.

Recently Banerji *et al.* have described a procedure to cleave propargyl ethers by use of low valent titanium (LVT)[7] reagent. Their reagent system can not be applied to substrates containing other functional groups like nitro and carbonyl which are easily reduced. With a view to study the selectivity of our methodology with substrates containing easily reducible groups, the reaction of nitro propargyl ether **8** with **1** was carried out and p-nitro phenol (**9**) was the exclusive product obtained in 96% yield. To study the selectivity in the presence of carbonyl group, propargyl ethers **10** and **14** were treated with **1** and the phenols **11** and **15** respectively were isolated in high yields. The reaction of ether **12** with **1** is particularly worth mentioning. Normally palladium reagents deprotect both allyl and propargyl groups without any discrimination. Interestingly when the ether **12** containing both allyl and propargyl groups was treated with **1**, the phenol **13** containing the allyl group was isolated in excellent yield. This kind of selectivity is very unique and is not normally observed with other reagents used for deprotection of ethers. The reaction of propargyl ether **16** containing an isolated carbon-carbon double bond led to the formation of the corresponding phenol **17** (86%) with the carbon-carbon double bond intact. The steroidal derivative **18** containing a free hydroxyl group poses no problems when treated with **1** and the phenol **19** could be isolated in very good yield.

Table I. Deprotection of Propargyl Ethers with **1**

Entry	substrate	Product[a]	Time(h)	Yield(%)[b]
1	$PhCH_2OR$ **2**	$PhCH_2OH$ **3**	48	73[d]
2	$CH_3(CH_2)_7OR$ **4**	$CH_3(CH_2)_7OH$ **5**	92	77[c,d]
3	(p) t-Bu $-C_6H_4OR$ **6**	(p) t-Bu $-C_6H_4OH$ **7**	24	75
4	(p) $O_2N-C_6H_4OR$ **8**	(p) $O_2N-C_6H_4OH$ **9**	12	96
5	(p) Et, C_6H_4OR **10**	(p) Et, C_6H_4OH **11**	19	87
6	(o) allyl-O $-C_6H_4OR$ **12**	(o) allyl-O $-C_6H_4OH$ **13**	24	81
7	**14**	**15**	18	87
8	**16**	**17**	36	86
9	**18**	**19**	48	82

R= $H_2C-C\equiv CH$

a) All the products gave satisfactory ^1HNMR, IR and mass spectra and were compared with authentic samples.
b) Yields refer to purified, isolated products.
c) 10% of the starting material was recovered.
d) DMF was used as a solvent.

In conclusion we have shown that tetrathiomolybdate **1**, a reagent that is cheap and is easily prepared,[8] can deprotect propargyl ethers under practically neutral conditions and with high degree of regioselectivity.

A Typical Experimental Procedure

To a stirred solution of propargyl ether (2 mmol) in CH_3CN (8 ml) tetrathiomolybdate **1** (2 mmol) was added at room temperature (28 ^{0}C). After stirring for 6 h at 28 ^{0}C another equivalent of **1** (2 mmol) was added. After completion of the reaction (tlc) a few drops of 2N HCl were added and the solvent was evaporated under reduced

pressure. The residue was extracted with CH_2Cl_2 -diethyl ether (1:5, 3 X 50 ml) and the solvent was removed to reveal the crude product which was purified by column chromatography over silica gel.

Acknowledgement. The authors thank the Department of Science and Technology, New Delhi for financial support of this investigation.

References and Notes

(1) Kunz, H.; Waldmann, H. *"Comprehensive Organic Synthesis,"* Eds. Trost, B. M.; Fleming, I. Pergamon Press, New York, **1990**, vol. 6, p. 631.
(2) Greene, T. W. *"Protective Groups in Organic Synthesis"*, John Wiley & Sons, New York, 2nd edn, **1991**.
(3) Ramesha, A. R.; Bhat, S.; Chandrasekaran, S. *J. Org. Chem.*, **1995**, 60, 7682.
(4) Prabhu, K. R.; Ramesha, A. R.; Chandrasekaran, S. *J. Org. Chem.*, **1995**, 60, 7142.
(5) Ramesha, A. R.; Chandrasekaran, S. *J. Org. Chem.*, **1994**, 59, 1354.
(6) Ilankumaran, P.; Manoj, N.; Chandrasekaran, S. *J. Chem. Soc., Chem.Commun.*, **1996**, 1957.
(7) Nayak, S. K.; Kadam, S. M.; Banerji, A. *Synlett*, **1993**, 581.
(8) Ramesha, A. R.; Chandrasekaran, S. *Synth. Commun.* **1992**, 22, 3277.