An Expedient and Efficient Method for the Cleavage of Dithioacetals to the Corresponding Carbonyl Compounds Using Organic Ammonium Tribromide (OATB)

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Abstract: A variety of dithioacetals of aldehydes or ketones **1** can be easily cleaved into the parent carbonyl compounds **2** at 0-5 °C in very high yields by employing organic ammonium tribromides such as cetyltrimethyl-ammonium tribromide (CetTMATB) or tetrabutylammonium tribromide (TBATB) in dichloromethane.

Key words: dithioacetals, deprotection, organic ammonium tribromide, cetyltrimethylammonium tribromide, tetrabutylammonium tribromide

Dithioacetal is well known as a protecting group¹ as well as an excellent acyl carbanion equivalent in organic synthesis.² Out of the various dithioacetals, diethyldithioacetal is extensively used as a protecting group in carbohydrate chemistry to prepare acyclic derivatives of monosacaccharides.³ Although a large number of methods have been developed for the regeneration of the carbonyl compounds from the corresponding dithioacetals, ^{1,4} there still is a need to find better alternatives. Unmasking of the carbonyl group sometimes requires long reaction times⁵ or toxic reagents such as mercury salts.⁶ Recently we have reported⁷ the synthesis of various organic ammonium tribromides (OATB) and their application for useful bromination reactions. The organic ammonium tribromide, namely TBATB is also used for oxidative bromination.⁸ We have realized that all other organic ammonium tribromides might be useful for other oxidation purposes.

In this communication, we wish to report organic ammonium tribromides (OATB) are useful reagents for oxidative cleavage of dithioacetals (Scheme).



Scheme

The starting dithioacetals are usually prepared by the reaction of the parent carbonyl compounds with ethanethiol or 1,3-propanedithiol in the presence of catalytic boron trifluoride etherate⁹ or concd hydrochloric acid, using

Entry	Substrate (1)	Method	Time in min	Product (2) ^a	Yield (%)
а	MeO-CH(SEt) ₂	A B	5 30	МеО-СНО	93 94
b	MeO MeO MeO	A B	15 5	MeO MeO MeO	95 96
c	MeO-CH(SEt) ₂	A B	5 5	МеО-СНО	85 80
d	O2N-CH(SEt)2	A B	30 30	O2N-CHO	90 88
e	CH(SEt) ₂	A B	5 15	СНО	95 94
f	SEt SEt	A B	5 2	\sim	78 95
g	CH ₃ (CH ₂) ₁₀ CH(SEt) ₂	A B	30 30	CH ₃ (CH ₂) ₁₀ CHO	85 82
h	SEt	A B	15 15		75 70
i	MeO-CHSS	A B	30 25	МеО-СНО	88 91
j	MeO MeO MeO	A B	30 30	MeO MeO MeO	82 86
k	OAc OAc OAc OAc	A B	30 30	OAc OAc OAc OAc	68 65

^a Products have been characterized by measuring IR, ¹H NMR, mass spectra and elemental analyses of the samples. ^bIsolated yield.

literature procedures. The deprotection step is achieved¹⁰ by treating the protected compounds **1** with cetyltrimethylammonium tribromide (CetTMATB, Method A) or tetrabutylammonium tribromide (TBATB, Method B) in dichloromethane at 0-5 °C. The reaction is completed within a short period. The results are summarized in the Table. The products are compared with the authentic compound by co-IR, mix melting point as well as characterized by ¹H NMR, mass spectra and elemental analyses. Interestingly, we have not observed any aromatic ring bromination or any other bromination by this procedure.

In conclusion, we have devised a simple and useful method for the regeneration of parent carbonyl compounds from the corresponding dithioacetals by employing cetyltrimethyl-ammonium tribromide (CetTMATB) or tetrabutylammonium tribromide (TBATB) under very mild reaction conditions. Due to its operational simplicity, generality and efficacy, this method is expected to have wider applicability for the cleavage of dithioacetals. A similar cleavage might also be possible by using other organic ammonium tribromides as well as other dithioacetals, which is under investigation.

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- (10) A typical procedure Method A: To a well stirred solution of diethyldithioacetal 2a (0.073 g, 0.3 mmol) in CH₂Cl₂ (7 mL) at 0-5 °C was added 0.157 g (0.3 mmol) of cetyltrimethyl ammonium tribromide (CetTMATB) and stirring was continued at the same temperature. The reaction was completed within 5 min as monitored by TLC. The reaction mixture was quenched by adding a 5% solution of sodium metabisulfite (1 × 10 mL), and finally extracted with CH₂Cl₂ (2 × 15 mL). The organic layers were washed with water (2 × 20 mL) and dried over anhydrous Na₂SO₄. Evaporation of solvent gave the crude product, which was finally purified by column chromatography on silica gel (eluent: hexane/EtOAc, 9:1). The product was obtained as colourless liquid 0.038 g (93%).
 - **Method B**: To a stirred solution of diethyldithioacetal **2a** (0.2 g, 0.83 mmol) in CH₂Cl₂ (7 mL) at 0-5 °C was added 0.4 g (0.83 mmol) of tetrabutylammonium tribromide (TBATB). The reaction was completed within 30 min as monitored by TLC. Usual work up and purification procedures were followed. The product was obtained as colourless liquid 0.106 g (94%).

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