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# A High Yielding, One-Pot, Triton-B Catalyzed Synthesis of Dithiocarbamates Using Alcoholic Tosylates[+]

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**Summary.** A novel process for the one-step chemoselective conversion of alcoholic tosylates into dithiocarbamates as protected amines was developed using benzyltrimethylammoniumhydroxide (Triton-B) in presence of carbon disulfide. Thus, dithiocarbamates of different amines were prepared in very good to excellent yields. This protocol is mild, chemoselective, and efficient compared to other reported methods.

**Keywords.** Triton-B; Carbon disulfide; Alcoholic tosylates; Dithiocarbamates; Thiocarbamation.

## Introduction

Organic dithiocarbamates have received much attention due to their interesting chemistry and wide utility. They have been extensively used as agrochemicals [1], pharmaceuticals [2], intermediates in organic synthesis [3], for protection of amino group in peptide synthesis [4], as linkers in solid phase organic synthesis [5], radical precursors in free radical chemistry [6], and recently in the synthesis of ionic liquids [7]. This necessitates their preparation through a convenient and safe methodology. To satisfy this demand, their synthesis should be changed from the use of harmful, toxic, and costly chemicals like dithiophosgene [8] and its derivatives [9] directly or indirectly, to the abundantly available, cheap, and safe reagents like $CS_2$. However, their formation by using $CS_2$ employed harsh reaction conditions such as use of strong bases, higher reaction temperatures, and long reaction times [10]. Thus, our group [11] has been engaged for the past several years with

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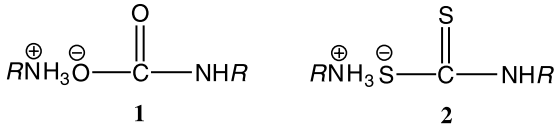
the development of new methodologies for the preparation of carbamates and dithiocarbamates using cheap, abundantly available, and safe reagents like $CO_2$ and $CS_2$. More recently [12], we realized that Triton-B is the best reagent for the synthesis of carbamates and dithiocarbamates from the corresponding alkyl halides. In the present communication, we report a chemoselective, highly efficient, one-pot synthesis of dithiocarbamates using the Triton-B/$CS_2$ system and alcoholic tosylates.

## Results and Discussion

We have recently assumed [12] that 2 mol equivalents of amine react with carbon dioxide to produce the monoalkylammonium alkylcarbamate ion **1**. By adopting a similar approach the monoalkylammonium alkyldithiocarbamate ion **2** should be obtained using $CS_2$ (Formulae 1).

This ionic species **2** gets stabilized in the presence of a phase transfer catalyst like Triton B and would react with alkylating agents to afford dithiocarbamates in high yields. Based on the concept of the formation of **2**, we investigated the synthesis of dithiocarbamates using alcoholic tosylates. The carbenium ion generated from the tosyl esters would undergo nucleophilic attack by $S^-$ of **2** leading to the formation of dithiocarbamates. Thus, when alcoholic tosylates were reacted with amines in dry *DMSO* at room temperature it led to the isolation of dithiocarbamates in high yields (78–98%). Moreover, due to higher reactivity of carbon disulfide than of carbon dioxide the reaction was tried at room temperature. Initially, the spectral characterisation of these dithiocarbamates was confirmed by the authentic dithiocarbamates prepared from their corresponding alkyl halides as reported previously [12b]. Later on, a variety of dithiocarbamates were prepared from a variety of primary, secondary, and tert. alcoholic tosylates using different aliphatic, aromatic, and cyclic amines as shown in Table 1. It was noted that due to the higher reactivity of the alcoholic tosylates as compared to alkyl halides the reaction was completed in less time with improved yields. The alcoholic tosylates [13] of different alcohols (primary, secondary, tertiary) were prepared by reacting alcohols with *p*-toluenesulfonyl chloride following the standard procedure. We tried several solvents like *n*-heptane, *n*-hexane, acetonitrile, benzene, toluene, methanol, dichloromethane, chloroform, *DMSO*, *DMF*, and *HMPA* of which dry *DMSO* proved to be the most suitable at room temperature. The reaction condition details are shown in Scheme 1.

In conclusion, we have developed a convenient and efficient protocol for a one-pot, three components coupling of various amines with a variety of alcoholic tosylates *via* Triton-B/$CS_2$. Our highly chemoselective reaction generates the corresponding dithiocarbamates in good to excellent yields without direct

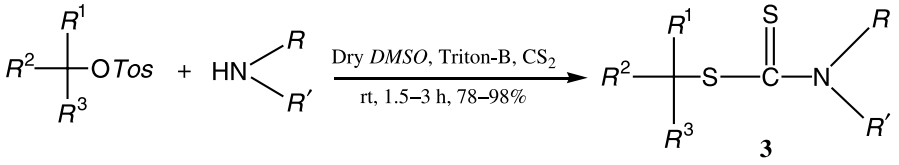



**1** **2**

**Formulae 1**

**Table 1.** Conversion of alcoholic tosylates into dithiocarbamates **3**

| Product | $R^1$ | $R^2$ | $R^3$ | $R$ | $R'$ | Time/h | Yield/% | Ref. |
|---|---|---|---|---|---|---|---|---|
| **3a** | 2-Naphthyloxypropyl | H | H | $n$-$C_4H_9$ | H | 2 | 94 | [12b] |
| **3b** | 2-Naphthyloxyethyl | H | H | $c$-$C_6H_{13}$ | H | 2.5 | 91 | [12b] |
| **3c** | 2-Naphthyloxyethyl | H | H | $R = R' =$ Morpholinyl | | 2.5 | 84 | [12b] |
| **3d** | $n$-$C_3H_7$ | H | H | $n$-$C_8H_{17}$ | H | 2.5 | 92 | [12b] |
| **3e** | $(CH_3)_2CH \cdot CH_2$ | H | H | $n$-$C_8H_{17}$ | H | 2.5 | 88 | |
| **3f** | $CH_3(CH_2)_3$ | H | H | $n$-$C_4H_9$ | H | 2.5 | 91 | |
| **3g** | $CH_3(CH_2)_4$ | H | H | $c$-$C_6H_{11}$ | H | 2.5 | 93 | [12b] |
| **3h** | $CH_3(CH_2)_4$ | H | H | $n$-$C_3H_7$ | H | 2.5 | 84 | |
| **3i** | $CH_3(CH_2)_6$ | H | H | 3-*Me*O*Ph*$CH_2$ | H | 2.5 | 82 | [12b] |
| **3j** | $CH_3(CH_2)_8$ | H | H | $n$-$C_6H_{13}$ | H | 1.5 | 98 | [12] |
| **3k** | *Ph*$CH_2$ | H | H | $n$-$C_4H_9$ | H | 2.5 | 90 | [12] |
| **3l** | *Ph*$CH_2 \cdot CH_2$ | H | H | $n$-$C_6H_{13}$ | H | 2 | 94 | [12b] |
| **3m** | *Ph*$CH_2$ | H | H | $i$-$C_3H_7$ | $i$-$C_3H_7$ | 2.5 | 84 | [12b] |
| **3n** | 2-Naphthyloxyethyl | H | H | 3-*Me*O*Ph* | H | 2 | 94 | [12b] |
| **3o** | $n$-$C_4H_9$ | $n$-$C_4H_9$ | H | $n$-$C_8H_{17}$ | H | 2.5 | 85 | |
| **3p** | $n$-$C_4H_9$ | $n$-$C_4H_9$ | $n$-$C_4H_9$ | $n$-$C_{12}H_{25}$ | H | 2.5 | 83 | |
| **3q** | $n$-$C_5H_{11}$ | H | H | *Ph* | H | 3 | 78 | |




**Scheme 1**

N-alkylation. Furthermore, this method exhibits substrate versatility, mild reaction conditions, and experimental convenience. This synthetic protocol is believed to offer a more general method for the formation of C–S bonds, essential to numerous organic syntheses.

## Experimental

Chemicals were obtained from Merck, Aldrich, and Fluka. IR spectra were run on a Bomem MB-104 FTIR spectrometer whereas $^1$H NMRs were scanned on an AC-300F NMR (300 MHz) instrument using $CDCl_3$ as solvent and *TMS* as internal standard. Elemental analyses were made by a Carlo-Erba EA1110 CNNO-S analyzer and agreed favorably with calculated values.

*Procedure*

A mixture of 6 mmol Triton-B and 6 mmol $CS_2$ was taken in 40 cm$^3$ dry *DMSO* and was allowed to stir for 20 min at room temperature. Amine (5 mmol) was added and the reaction was continued at rt for 1 h. Now 2 mmol corresponding alcoholic tosylate were added. The reaction was further continued until completion (*cf.* Table 1). The reaction mixture was poured into 50 cm$^3$ distilled $H_2O$ and extracted with ethyl acetate thrice. The organic layer was separated, dried ($Na_2SO_4$), and concentrated to get the desired compound.

*Isoamyl n-octyldithiocarbamate* (**3e**, $C_{14}H_{29}NS_2$)
Oil; IR (Neat): $\bar{\nu} = 1105\,cm^{-1}$ (S–C=S, thiocarbamate linkage) $cm^{-1}$; $^1H$ NMR ($CDCl_3$): $\delta = 0.92$–$0.96$ (t, $CH_3$ of *n*-octyl group), 1.01–1.05 (d, $CH_3$ of *i*-amyl group), 1.29–1.33 (m, $CH_2$ of *n*-octyl group), 1.53–1.55 (m, $CH_2$ of *i*-amyl and *n*-octyl group), 1.83–1.85 (m, C*H* of *i*-amyl group), 2.0 (br, NH), 2.62–2.65 (t, NH*CH*$_2$ of *n*-octyl group), 2.85–2.87 (t, $CH_2$–S– of *i*-amyl group) ppm; Ms: $m/z = 275$.

*Pentyl n-butyldithiocarbamate* (**3f**, $C_{10}H_{21}NS_2$)
Oil; IR (Neat): $\bar{\nu} = 1110\,cm^{-1}$; $^1H$ NMR ($CDCl_3$): $\delta = 0.93$–$0.97$ (t, $CH_3$ of *n*-pentyl and *n*-butyl group), 1.29–1.33 (m, $CH_2$ of *n*-pentyl and *n*-butyl group), 1.93–1.97 (m, $CH_2$ of *n*-butyl and *n*-pentyl group), 2.2 (br, NH), 2.63–2.66 (m, *CH*$_2$NH), 2.83–2.85 (t, *CH*$_2$–S–) ppm; Ms: $m/z = 219$.

*n-Hexyl n-propyldithiocarbamate* (**3h**, $C_{10}H_{21}NS_2$)
Oil; IR (Neat): $\bar{\nu} = 1114\,cm^{-1}$; $^1H$ NMR ($CDCl_3$): $\delta = 0.93$–$0.96$ (t, $CH_3$ of *n*-hexyl and *n*-propyl group), 1.29–1.33 (m, $CH_2$ of *n*-hexyl and *n*-propyl group), 1.56–1.59 (m, $CH_2$ of *n*-propyl group), 2.2 (br, NH), 2.63–2.65 (t, *CH*$_2$NH) 2.85–2.87 (t, *CH*$_2$–S– of *n-hex*yl group) ppm; Ms: $m/z = 219$.

*Isobutyl n-octyldithiocarbamate* (**3o**, $C_{18}H_{37}NS_2$)
Oil; IR (Neat): $\bar{\nu} = 1108\,cm^{-1}$; $^1H$ NMR ($CDCl_3$): $\delta = 0.95$–$0.98$ (t, $CH_3$ of *i*-butyl and *n*-octyl group), 1.29–1.33 (m, $CH_2$ of *i*-butyl and *n*-octyl group), 1.55–1.58 (m, $CH_2$ of *i*-butyl and *n*-octyl group), 1.92–1.94 (m, *CH*$_2$CH of isobutyl group), 2.22 (br, NH), 2.52–2.54 (m, *CH*–S) ppm; Ms: $m/z = 331$.

*tert. Butyl n-dodecyldithiocarbamate* (**3p**, $C_{26}H_{53}NS_2$)
Oil; IR (Neat): $\bar{\nu} = 1111\,cm^{-1}$; $^1H$ NMR ($CDCl_3$): $\delta = 0.95$–$0.98$ (t, $CH_3$ of *t*-butyl and *n*-dodecyl group), 1.29–1.33 (m, $CH_2$ of *t*-butyl and *n*-dodecyl group), 1.55–1.58 (m, $CH_2$ of *n*-dodecyl group), 1.88–1.90 (t, *CH*$_2$C of *t*-butyl group), 2.20 (br, NH), 2.63–2.65 (m, *CH*$_2$NH) ppm; Ms: $m/z = 443$.

*n-Hexyl phenyldithiocarbamate* (**3q**, $C_{13}H_{19}NS_2$)
Oil; IR (Neat): $\bar{\nu} = 1119\,cm^{-1}$; $^1H$ NMR ($CDCl_3$): $\delta = 0.94$–$0.97$ (t, $CH_3$ of *n*-hexyl group), 1.29–1.33 (m, $CH_2$ of *n*-hexyl group), 1.95–1.96 (m, *CH*$_2$CH$_2$S of *n*-hexyl group), 2.85–2.87 (t, *CH*$_2$–S– of *n*-hexyl group), 4.01 (br, NH), 6.46–7.02 (m, Ph protons) ppm; Ms: $m/z = 253$.

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