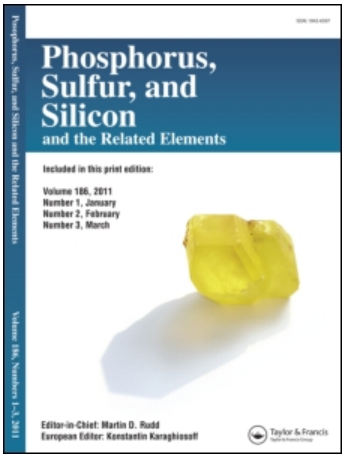


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# Efficient Conversion of Tetrahydropyranyl (THP) Ethers to Their Corresponding Thiocyanates With in-situ-Generated $Ph_3P(SCN)_2$

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# Efficient Conversion of Tetrahydropyranyl (THP) Ethers to Their Corresponding Thiocyanates With in-situ–Generated $Ph_3P(SCN)_2$

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*Immediate and efficient one-pot conversion of tetrahydropyranyl (THP) ethers to their corresponding thiocyanates by in-situ–generated $Ph_3P(SCN)_2$ is described. Primary and secondary alkyls and also benzylic THP ethers are converted to their corresponding thiocyanates in excellent yields at room temperature by this method.*

**Keywords** $Ph_3P(SCN)_2$; tetrahydropyranyl ethers; thiocyanates



## INTRODUCTION

Tetrazoles are important aromatic heterocyclic compounds and their use in medicinal chemistry is well established.[1] Thiocyanates are considered important and valuable sulfur-containing compounds for the synthesis of heterocycles such as tetrazoles and traditionally have been used as pesticides.[2]

Tetrahydropyranylation is one of the most practical and popular ways of protecting hydroxyl groups of alcohols and phenols, especially in the synthesis of multifunctional organic molecules. THP ethers show remarkable stability toward organometallic reagents, reduction with hydrides, oxidation, oxidative alkylation, and so on. Transformation of protected functional groups to other functionalities is of practical value in organic synthesis.[3,4] Literature research reveals that few reports are available for direct conversion of THP ethers to other functional

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groups. The examples are conversion to bromides,[5] sulfides,[6] acetates[7] into their esters.[8] Recently, we have reported the conversion of a variety of silyl ethers[9] and alcohols[10] to their corresponding thiocyanates by in-situ–generated $Ph_3P(SCN)_2$.

## RESULTS AND DISCUSSION

In this article we wish to report the efficient conversion of THP ethers into their corresponding thiocyanates at room temperature (Scheme 1).

$$\mathrm{ROTHP} \xrightarrow[\text{rt, immediately}]{\mathrm{Ph_3P(SCN)_2, CH_3CN}} \mathrm{RSCN}$$

R = prim., sec. alkyl and benzyl

**SCHEME 1**

The reaction has been performed in dry $CH_3CN$ with in-situ–generated $PPh_3(SCN)_2$ obtained from the reaction of $PPh_3{\cdot}Br_2$ and $NH_4SCN$. $^{31}$P-NMR confirms the in-situ generation of $PPh_3(SCN)_2$ that is in agreement with the data reported in the literature.[11] By the presented method, benzyl and 4-substituted benzyltetrahydropyranyl ethers with electron-withdrawing groups were transformed to their corresponding thiocyanates in excellent yields (92–95%) without the formation of any isothiocyanate as a byproduct. A previous report indicates that the preparation of benzylthiocyanate from benzyl alcohol that is free from its isothiocyanate isomer is a difficult task due to the formation of a substantial amount of benzylisothiocyanate.[12]

4-Methoxybenzyltetrahydropyranyl ether was converted to its corresponding thiocyanate in 88% that was accompanied with the formation of isothiocyanate in only a 12% yield (Entry 4, Table I). Primary and secondary saturated tetrahydropyranyl ethers (Entries 5–8, Table I) were also transformed to their corresponding thiocyanates in excellent yields (87–94%).

This method is not suitable for the preparation of thiocyanates from highly hindered THP ethers. For example, the THP ether of diphenylmethanol was converted to its corresponding thiocyanate[15c] in a 12% yield and isothiocyanate[15d] in a 73% yield.

In conclusion, in this article we have presented a new useful method for the one-pot preparation of thiocyanates from THP ethers in high yield under mild reaction conditions.

**TABLE I Conversion of THP Ethers to Thiocyanates**

| Entry | R-OTHP | % Total yield[a] | % RSCN[b,c] | % RNCS[b] |
|---|---|---|---|---|
| 1 | $C_6H_5CH_2OTHP$ | 94 | 100[11,13,15a] | 0 |
| 2 | 4-$NO_2C_6H_4CH_2OTHP$ | 95 | 100[11,13] | 0 |
| 3 | 4-$ClC_6H_4CH_2OTHP$ | 92 | 100[11,13] | 0 |
| 4 | 4-$MeOC_6H_4CH_2OTHP$ | 95 | 88[11,13] | 12 |
| 5 | $C_6H_5CH_2CH_2OTHP$ | 94 | 100[11] | 0 |
| 6 | $CH_3(CH_2)_6CH_2OTHP$ | 93 | 97[11] | 3 |
| 7 | $CH_3(CH_2)_5CH(CH_3)OTHP$ | 90 | 95[14] | 5 |
| 8 | $PhCH(CH_2CH_3)OTHP$ | 87 | 96[15b] | 4 |

[a]The products were identified by comparison of their physical data with those reported for known samples.

[b]The percentage of the products in the reaction mixture was determined by $^1$H-NMR and $^{13}$C-NMR.

[c]Reference to the product.



## EXPERIMENTAL

Products were characterized by comparison of their physical data with those of a known sample. IR spectra were recorded on a Perkin Elmer 781 and Pye Unicam 8725 spectrometers. NMR spectra were recorded on a Bruker DPX 250. The purity determination of the substrates and reaction monitoring were accomplished by TLC on silica gel polygram SILG/UV 254 plates or GLC on a Shimadzu GC-14A instrument.

## GENERAL PROCEDURE FOR THE SYNTHESIS OF 1° AND 2° THIOCYANATES FROM THP ETHERS

A three-necked flask equipped with a dropping funnel, stirrer, drying $CaCl_2$ tube, and $N_2$ gas inlet was charged with $Ph_3P$ (2.2 mmol) and dry $CH_3CN$ (5 mL), then $Br_2$ (2.2 mmol) was added dropwise to the solution at room temperature under $N_2$ atmosphere. When the addition was completed, a solution of $NH_4SCN$ (4.4 mmol) in $CH_3CN$ (5 mL) was added dropwise. Upon addition of THP ether (2 mmol) to the resulting mixture, an spontaneous reaction occurred. To the resulting mixture, silica gel was added and the solvent was evaporated on a rotary evaporator. The resulting solid was applied on a silica gel column and washed by petroleum ether 60–80°C/EtOAc (9/1) to give the desired thiocyanate (Table I).

## REFERENCES

[1] B. W. Leblanc and B. S. Jursic, *Synth. Comm.*, **28,** 3591 (1998).

[2] A. A. Newman, *Chemistry and Biochemistry of Thiocyanic Acid and Its Derivatives*, 1st ed., Academic Press, 1975.

[3] A. J. Pearson and W. J. Roush, *HandBook of Reagents for Organic Synthesis Activating Agents and Protecting Groups*, 1st ed. New York: Wiley, 1999.
[4] T. W. Greene and P. G. M. Wuts, *Protective Groups in Organic Synthesis*, 2nd ed. New York: Wiley, 1991.
[5] (a) A. Tanaka and T. Oritani, *Tetrahedron Lett*., **38,** 1955 (1997). (b) A. Wagner, M.-P. Heitz, and C. Mioskowski, *Tetrahedron Lett*., **30,** 557 (1989).
[6] T. Sato, J. Otera, and H. Nozaki, *J. Org. Chem*., **55**, 4770 (1990).
[7] S. Chandrasekhar, T. Ramachandar, M. V. Reddy, and M. Takhi, *J. Org. Chem.*, **65,** 4729 (2000).
[8] S. Kim and W. J. Lee, *Synth. Commun*., **16,** 659 (1986).
[9] N. Iranpoor, H. Firouzabadi, and H. Shaterian, *Synlett. Lett*., 65 (2000).
[10] N. Iranpoor, H. Firouzabadi, and H. R. Shaterian, *J. Chem. Res.(S)*. 676 (1999).
[11] (a) J. Burski, J. Kieszkowski, J. Michalski, M. Pakulski, and A. Skowronska, *Tetrahedron*, **39,** 4175 (1983); (b) S. Kagabu, K. Sawahara, M. Maehara, S. Ichihashi, and K. Saito, *Chem. Pharm. Bull*., **39,** 784 (1991).
[12] W. P. Reeves, M. R. White, R. G. Hilbrich, and L. L. Biegert, *Synth.Commun*., **6,** 509 (1976).
[13] Y. Tamura, T. Kawasaki, M. Adachi, M. Tanio, and Y. Kita, *Tetrahedron Lett*., **50,** 4417 (1977).
[14] M. Kodomari, T. Kuzuoka, and S. Yoshitomi, *Synthesis*, 141 (1983).
[15] Spectral data for (a) Benzyl thiocyanate: IR (KBr disc); $\nu(Cm^{-1})$: 3086, 3070, 3009, 2992, 2918, 2148, 1494, 1464, 1427, 1246, 1204, 1076, 769, 698, 645. $^1$H-NMR ($CDCl_3$, 250 MHz), $\delta$(ppm): 4.2 (2H, s), 7.4 (5H, s); $^{13}$C-NMR ($CDCl_3$, 63 MHz), $\delta$(ppm): 134.47, 129.05, 128.93, 128.80, 111.96, 38.20; MS (70 eV) m/z (% relative intensity): 149($M^+$, 3), 92(8), 91(100), 89(3), 65(12), 63(3), 51(3), 39(6). (b) (1-thiocyanato-propyl)-benzene: IR ($CCl_4$); $\nu(Cm^{-1})$: 3050, 3040, 2980, 2940, 2890, 2165, 1500, 1460, 1240, 1100, 1040, 750, 690. $^1$H-NMR($CDCl_3$, 250 MHz), $\delta$(ppm): 0.96(3H,t), 2.1(2H,m), 4.6(1H,t), 7.2–7.4(5H,m). $^{13}$C-NMR($CDCl_3$, 63 MHz), $\delta$(ppm): 137.1, 127.8, 127.7, 124.7, 111.9, 54.2, 31.3, 11.1. (c) 1-Thiocyanato-1,1-diphenyl methane: IR($CCl_4$); $\nu(Cm^{-1})$: 3080, 3040, 2950, 2160, 1500, 1460, 1200, 1120, 1040, 1010, 750, 710. $^1$H-NMR($CDCl_3$, 250 MHz), $\delta$(ppm): 5.3(1H,s), 7.2–7.5(10H,m). $^{13}$C-NMR($CDCl_3$, 63 MHz), $\delta$(ppm): 131.5, 130.5, 130.4, 130.1, 112.2, 58.1. (d) 1-Isothiocyanato-1,1-diphenyl methane: IR($CCl_4$); $\nu(Cm^{-1})$: 3060, 3050, 2950, 2060, 1490, 1450, 1180, 1030, 750, 700. $^1$H-NMR($CDCl_3$, 250 MHz), $\delta$(ppm): 5.8(1H,s), 7.1–7.3(10H,m). $^{13}$C-NMR($CDCl_3$, 63 MHz), $\delta$(ppm): 142.9, 130.8, 129.8, 129.6, 128.2, 65.3.