

A MILD AND EFFICIENT TETRAHYDRO-PYRANYLATION AND DETETRAHYDROPYRANYLATION OF ALCOHOLS AND PHENOLS BY VCl_3

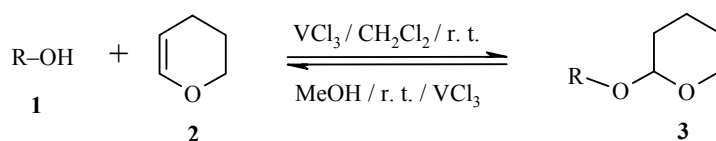
P. Narsimha Reddy, B. Sunil Kumar, P. S. Kumar, N. Srinivasulu, Y. Thirupathi Reddy, and B. Rajitha

Vanadium chloride is found to be an efficient catalyst for the tetrahydropyranylation and detetrahydropyranylation of various alcohols and phenols, giving good yields at room temperature and short reaction times.

Keywords: alcohols, phenols, VCl_3 , detetrahydropyranylation, tetrahydropyranylation.

Tetrahydropyranylation and detetrahydropyranylation of alcohols and phenols is well established in organic synthesis [1]. Tetrahydropyranylation of hydroxyl groups using 3,4-dihydro-2H-pyran (DHP) has been recognized as a useful method for the protection of alcohols and phenols [2] due to its ease of introduction and deprotection. Tetrahydropyranyl ethers are stable under a variety of reaction conditions and reagents like strong bases, Grignard reagents, redox reagents, metal hydrides, metal alkyls, and catalytic hydrogenation [2, 3].

Several catalysts have been reported for the tetrahydropyranylation and detetrahydropyranylation of alcohols and phenols, including protic acids [4], Lewis acids like BF_3 -etherate [5], $LiBr$ [6], $LiBF_4$ [7], $LiOTf$ [8], $LiClO_4$ [9], $Sc(OTf)_3$ [10], $In(OTf)_3$ [11], I_2 [12], $InCl_3$ [13], $ZrCl_4$ [14], $CuCl_2$ [15], NH_4Cl [16] and expansive graphite [17], clay materials [18], silica sulfuric acid [19], and miscellaneous other catalysts [20-26]. Most of the existing methods are associated with various drawbacks, including long reaction time, low yields, reflux at high temperature, and tedious experimental procedure. Hence, there is still a need to develop a simple and efficient method for tetrahydropyranylation and detetrahydropyranylation of alcohols and phenols. In this communication we report the use of catalytic amounts of VCl_3 for protection and deprotection of alcohols and phenols with DHP.



Tetrahydropyranylation and detetrahydropyranylation of alcohols and phenols was achieved in the presence of a catalytic amount of VCl_3 in excellent yields in short reaction times at ambient temperature (Table 1). A wide range of hydroxyl compounds such as primary, secondary, tertiary, benzylic, and cyclic alcohols and phenols underwent effective tetrahydropyranylation and detetrahydropyranylation at room temperature.

Department of Chemistry, National Institute of Technology, Warangal, (A. P) India; e-mail: rajitabhargavi@yahoo.com. Published in *Khimiya Geterotsiklicheskih Soedinenii*, No. 11, pp. 1634-1636, November, 2005. Original article submitted August 7, 2005.

TABLE 1. VCl_3 Catalyzed Tetrahydropyranylation and Detetrahydropyranylation of Alcohols and Phenols*

Alcohol	Tetrahydropyranylation		Detetrahydropyranylation	
	Time, min	Yields, % ^{*2}	Time, min	Yield, % ^{*2}
Benzyl alcohol [7]	10	97	15	95
4-Chlorobenzyl alcohol [7]	20	94	25	92
4-Methoxybenzyl alcohol [19]	15	92	20	91
Phenol [7]	10	95	20	93
4-Methoxyphenol [6]	20	96	25	95
4-Methylphenol [14]	15	93	25	90
2-Propanol [19]	10	95	20	91
2-Methyl-2-propanol [14]	15	97	20	93
Cyclohexanol [7]	20	92	25	92
1-Naphthol [6]	25	94	25	91
1-Menthol [7]	20	90	25	92

* All the tetrahydropyranyl ethers are known compounds.

*² Yields refer to pure products; all products were characterized by comparison of their physical and spectral data with those of authentic samples.

EXPERIMENTAL

General Procedure for Protection of Alcohols and Phenols. VCl_3 (0.1 mmol) was added to a solution of alcohol (1 mmol) and DHP (1 mmol) in dry dichloromethane (20 ml). The mixture was stirred for a specific period of time (Table 1). The progress of the reaction was monitored by TLC. After disappearance of the starting material the catalyst was filtered. The solvent was evaporated in vacuo. Water (10 ml) was added and the mixture was extracted with ether (2 × 20 ml). The separated organic layer was dried over Na_2SO_4 . Solvent evaporation gave pure THP ethers.

General Procedure for Deprotection of Tetrahydropyranyl Ethers of Alcohols and Phenols. A mixture of THP-ether (10 mmol) in methanol (20 ml) was added to VCl_3 (0.1 mmol) and stirred at room temperature for a specific period of time (Table 1). The progress of the reaction was monitored by TLC. After disappearance of the starting material the catalyst was filtered off. The solvent was evaporated in vacuo. Water was added (10 ml) and the mixture was extracted with ether (2×20 ml). The separated organic layer was dried over Na_2SO_4 . Solvent evaporation gave pure alcohols.

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