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A CHEMOSELECTIVE CONVERSION OF ALKYL AND ARYL AZIDES TO AMINES WITH SODIUM HYDROGENTELLURIDE

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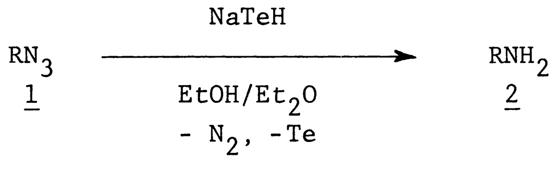
By treatment with sodium hydrogentelluride in ethanol/ether at room temperature, alkyl and aryl azides are easily converted to the corresponding primary amines in good yields.

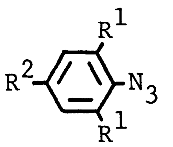
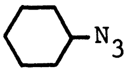
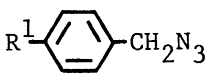
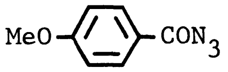
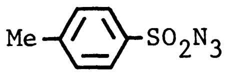
The transformation of azides into amines is a synthetically important process and its value has been well established, particularly in the field of carbohydrate and nucleoside synthesis. Since various alkyl azides are readily available by the S_N2 azidolysis of alkyl halides and tosylates, the reaction has been widely exploited for the regio- and stereospecific introduction of amino moiety.1) Many procedures have been reported for the reduction of azides to amines; catalytic hydrogenation;2) reduction with metal hydrides,3) triphenylphosphine,4) thiol and sulfide,5) diborane,6) and low valent species of transition metals;7) and several other methods of limited scope.8) Some of these are, however, quite drastic and incompatible with the presence of other groups.

Sodium hydrogentelluride (NaTeH), which is readily prepared from tellurium and sodium borohydride,9) has recently been shown to possess unique reduction ability for a variety of organic molecules.10) We wish to report herein that the above reagent can effect the azido to amino conversion with remarkable ease and high chemoselectivity under mild conditions. Thus, treatment of azide 1 with sodium hydrogentelluride in ethanol/ether at room temperature causes rapid evolution of nitrogen with precipitation of metallic tellurium, and the corresponding primary amine 2 is formed in good yields (Table 1).



$$\underset{\underline{1}}{RN_3} \xrightarrow[\substack{EtOH/Et_2O \\ -\ N_2,\ -Te}]{NaTeH} \underset{\underline{2}}{RNH_2}$$

Table 1. Reduction of azides 1 to amines 2[a)]

Azide	Yield/% [b,c)]	Azide	Yield/% [b,c)]
		n-$C_4H_9N_3$	69
$R^1 = R^2 = H$	~100		75
$R^1 = Me; R^2 = H$	~100		
$R^1 = H; R^2 = Cl$	~100	Ph_3CN_3	55
			75
$R^1 = H$	81		
$R^1 = PhCO$	75		76
$R^1 = CO_2Me$	~100		
$R^1 = PhSO_2$	71		

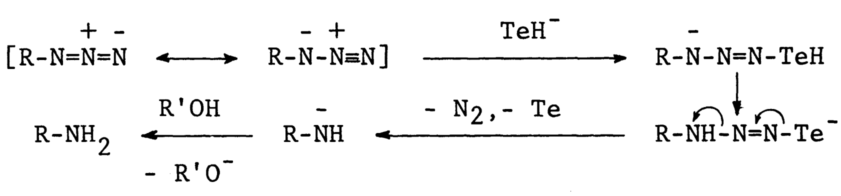
a) All reactions were carried out under rigorous exclusion of air at ambient temperatures. Reaction time was 15 min.

b) Liquid products were converted to tosylamide derivatives and identified by direct comparison with authentic specimens.

c) Yields refer to the isolated compounds and are not optimized.

The reaction is clean and free from by-products which often accompany the reduction when strong agents are used. As seen from the Table, the method is of general applicability and mild enough to permit the reduction of azide in the presence of a variety of potentially reducible functionalities; unconjugated carbon-carbon double and triple bonds, unconjugated carbonyl, carboxyl, amide, ester, nitrile, haloaryl, nonactivated haloalkyl, and sulfone groups are known to be inert toward sodium hydrogentelluride.

Although the mechanism of the reduction with hydrogentelluride anion has not been studied, a probable pathway is illustrated below:



General procedure is as follows: A mixture of powdered tellurium (0.65 g; 5.0 mmol), sodium borohydride (0.45 g; 11.9 mmol), and ethanol (10 ml) is heated under reflux in an atmosphere of nitrogen until tellurium disappears. After cooling to room temperature, a solution of azide (2.0 mmol) in ether (10 ml) is added by syringe technique to the dark red solution of sodium hydrogentelluride. The color immediately turns black, and is followed by rapid evolution of nitrogen and precipitation of metallic tellurium. After standing for a while, the mixture is left open to air with stirring to destroy excess reagent, and then filtered through Celite. The filtrate is evaporated to obtain the amine or amide 2.

The major advantages of the present method are; (1) the reaction proceeds fast under mild conditions. It is clean with no appreciable side products being formed; (2) the products are easily isolable, and free from impurities arising from the reducing agent employed; (3) the reagent is readily prepared and is inexpensive; (4) the method is compatible with various functional groups which are sensitive to common reducing agents; (5) excess reagent can be used without any disadvantage and is easily destroyed by bubbling air into the solution. Recovered tellurium may be reused.

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