

SELECTIVE REDUCTION OF  $\alpha,\beta$ -UNSATURATED CARBONYL COMPOUNDS  
BY SODIUM HYDROTELLURIDE

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Sodium hydrotelluride was found to serve as a new efficient agent for selective reduction of  $\alpha,\beta$ -unsaturated carbonyl compounds under mild reaction conditions.

Selective reduction of  $\alpha,\beta$ -unsaturated carbonyl compounds (ketones, aldehydes, esters, lactones, etc.) is one of the most important organic reactions.<sup>1,2)</sup> In this letter, we wish to report that sodium hydrotelluride (NaHTe) (I), prepared from tellurium powder and sodium borohydride,<sup>3)</sup> is found to be a useful and practical reducing agent for these compounds. As exemplified in Table 1, this reaction is applicable to a wide variety of  $\alpha,\beta$ -unsaturated carbonyl compounds including ketones, aldehydes, esters, lactones, etc.

Representative procedure is as follows. To a solution of (I), prepared *in situ* from tellurium powder (0.65 g) and sodium borohydride (0.45 g) in ethanol (20 ml),<sup>3)</sup> was added an ethanol solution (2 ml) of 3-phenylpropanal (2 mmol) under argon. The reaction mixture was stirred at room temperature for 4-5 h. Then the mixture was filtered through Celite and the filtrate was evaporated. The residual liquid was almost pure 3-phenylpropanal (examined by GLC). The product was purified by distillation and identified by IR, NMR, MASS, and GLC.

The present procedure possesses the following characteristics: a) over-reduction of the carbonyl groups and ester functions is negligible; b) isolated carbon-carbon double bonds are not reduced; c) phenyl and furyl groups are not affected; d) the operation is very simple (filtration of the reaction solution through Celite and evaporation give almost pure products).

Table 1. Reduction of  $\alpha,\beta$ -unsaturated carbonyl compounds by NaHTe<sup>a)</sup>

Run	Carbonyl Compound	Product	Yield (%) <sup>b)</sup>
1			> 99
2			> 99
3			> 99
4			> 99
5			> 99
6			> 99
7			> 99
8			36
9	$\text{H}_5\text{C}_2\text{OCO}-\text{CH}=\text{CH}-\text{COOC}_2\text{H}_5$ <sup>c)</sup>	$\text{H}_5\text{C}_2\text{OCO}-\text{CH}_2\text{CH}_2-\text{COOC}_2\text{H}_5$	5

a) At room temperature for 4-5 h under argon. b) Determined by GLC.  
c) Diethyl maleate.

As to the stereochemistry of the reaction, (-)-carvone was converted selectively into (+)-dihydrocarvone (Run 6).<sup>4)</sup> This shows that (I) attacks (-)-carvone exclusively from the sterically less hindered site.

1,4-Dicarbonyl compounds such as diethyl maleate and *p*-quinone were also reduced (Runs 8 and 9), but the yields were low.<sup>5)</sup> Scope and limitation of this reaction are now under investigation.

#### References and Notes

- 1) M. Smith in "Reduction," R. L. Augustine, Ed., Marcel Dekker, New York, N. Y., 1968, p 95.
- 2) R. Noyori, I. Umeda, and T. Ishigami, *J. Org. Chem.*, **37**, 1542 (1972), and the references cited therein.
- 3) D. H. R. Barton and S. W. McCombie, *J. Chem. Soc. Perkin I*, **1975**, 1574.
- 4) (+)-Isodihydrocarvone, diastereomer of (+)-dihydrocarvone, was not detected by GLC.
- 5) The remainder consisted mainly of the starting material. Side reactions were negligible.

(Received April 26, 1980)