18. A. F. Hebard, M. J. Rosseinsky, R. C. Haddon, D. W. Murphy, S. H. Glarum, T. T. M. Palstra, A. P. Ramirez, and A. R. Kortan, *Nature*, **350**, 600 (1991).

Selective Reduction by Lithium Bis- or Tris(dialkylamino)aluminum Hydrides. IV. Transformation of Primary Carboxamides to Aldehydes by Lithium Tripiperidinoaluminum Hydride[1]

Jin Soon Cha*, Jae Cheol Lee, Heung Soo Lee, and Sung Eun Lee

Department of Chemistry, Yeungnam University, Kyongsan 712-749

Received June 4, 1991

The development of simple synthetic routes to aldehyde from readily available carboxylic acids and their derivatives is an important goal in organic chemistry. During the past some 70 years, numerous efforts have been made to find simple and general synthetic routes to aldehyde[2,3]. However, there have been lacking in methods for direct conversion of primary carboxamides into aldehydes[1].

In the course of exploring the reducing characteristics of lithium dialkylaminoaluminum hydrides, we found that lithium tripiperidinoaluminum hydride (LTPDA), readily prepared from the reaction of lithium aluminum hydride and 3 equiv. of piperidine in THF at 0℃[4], effects such transformation in good yields.

Excess LTPDA reduces both aliphatic and aromatic primary carboxamides slowly, requiring 1 or 2 days at room temperature, with concurrent evolution of hydrogen[5] (1 equiv. for aliphatics and 2 equiv. for aromatics).

In general, the yields from aliphatic carboxamides examined are varying with the structure, showing yields in the range of 50-80%, except for acetamide, 2-chloroacetamide, and methacrylamide.

Reductions of acetamide and methacrylamide afford poor yields of the corresponding aldehydes. However, the reagent readily converts aromatic primary carboxamides into the corresponding aldehydes in yields of 80-90%, with the exception of nitrobenzamide. The nitro group itself appears to be reduced readily by this reagent under the reaction conditions. Derivatives bearing alkyl, alkoxy, or halogeno groups are readily accommodated. Nicotinamide is also reduced to the corresponding aldehyde in a moderate yield.

The following procedure for the reduction of benzamide is illustrative. An oven-dried, 200 ml flask, fitted with a side arm and a bent adapter leading to a mercury bubbler, was flushed with dry nitrogen and charged with 6.42 g (53 mmol) of benzamide and 120 ml of THF. To this mixture was added 106 ml of 1.50 M LTPDA (159 mmol) solution in THF slowly at room temperature and the mixture was stirred for 24 h at that temperature. An amount less than 2 equiv. of hydrogen was evolved slowly. Analysis of an aliquot with (2, 4-dinitrophenyl)hydrazine yielded 92% of the corresponding aldehyde.

Table 1. Yields of Aldehydes in the Reduction of Representative Primary Carboxamides with Lithium Tripiperidinoaluminum Hydride in Tetrahydrofuran at Room Temperature[a]

Amide	Reaction time (h)	Yield of aldehyde (%)[b]
Acetamide	48	37
2-Chloroacetamide	48	20
Trimethylacetamide	48	72
n-Butyramide	48	42
Isobutyramide	24	73
Methacrylamide	24	24
Caproamide	24	66(57)[c]
Octadecaneamide	48	84
Cyclohexane-carboxamide	48	60
Benzamide	24	92(81)[d](88)[c]
o-Toluamide	24	89
4-Methoxybenzamide	24	94(82)[d]
2-Ethoxybenzamide	30	82
2-Chlorobenzamide	24	83
2-Nitrobenzamide	24	34
Nicotinamide	24	53

[a] Ratios of reagent to compound are 2 : 1 for aliphatics and 3 : 1 for aromatics. [b] Analyzed with (2,4-dinitrophenyl)hydrazine. [c] Reacted for 3 h at 50℃. [d] Yields based on the analytically pure aldehydes isolated by the sodium bisulfite procedure.

The rest of the reaction mixture (50 mmol) was hydrolyzed with 3 N H_2SO_4 and then saturated with sodium chloride. The separated organic layer was subjected to the sodium bisulfite isolation procedure[6] to provide an analytically pure benzaldehyde (81%).

Acknowledgement. The authors thank the Organic Chemistry Research Center-KOSEF, Korea for the financial support.

References

1. The series III; J. S. Cha, J. C. Lee, S. E. Lee, and H. S. Lee, *Tetrahedron Lett.*, **31**, 000 (1991).
2. (a) I. T. Harrinson, H. Harrison, I. S. Hegedus, L. Wade, and L. G. Wade, Jr., "Compendium of Organic Synthetic Methods", Wiley-Interscience, N. Y., Vol. I-V (1971-1984); (b) R. C. Larock, "Comprehensive Organic Transformations", VCH Publisher, Inc. (1989).
3. For reviews; (a) E. Misettig, *Org. React.*, **8**, 218 (1954); (b) J. S. Cha, *Org. Prep. Proced. Int.*, **21**, 451 (1989).
4. The ^{27}Al-NMR showed a bread singlet at δ 123.5 ppm relative to $Al(H_2O_6)^{3+}$.
5. The reaction of carboxamides with excess LTPDA under the standardized reaction conditions (THF, 0℃) was performed in an usual manner. See the procedure depicted in the series II in this journal. The results on the reaction of selected organic compounds with LTPDA will be reported in a separate paper.
6. (a) H. C. Brown, J. S. Cha, B. Nazer, and N. M. Yoon, *J. Am. Chem. Soc.*, **106**, 8001 (1984); (b) *idem., J. Org. Chem.*, **52**, 54 (1987).