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THE SELECTIVE N,N-DIALKYLATION OF PRIMARY AMINES USING CARBONYLFERRATE

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N,N-Dialkylation of primary amines was successfully carried out in the presence of carbonyl compounds and carbonylferrate.

A selective, general procedure for N-alkylation of amines has long been of interest. Several methods for synthesis of N-alkylamines from amines and carbonyl compounds have been reported.[1)] The methods have been successfully carried out through hydrogenolysis or reduction of the condensation products derived from an amine and a carbonyl compound with hydrogen or reducting agents such as sodium borohydride. These procedures generally give satisfactory results but have some limited applicabilities and require drastic conditions.

The previous works in our laboratory have demonstrated that carbonylferrate is an excellent reagent for the reductive amination of carbonyl compounds.[2)] In this communication we wish to report a simple and convenient method for N,N-dialkylation of amines using the carbonylferrate.

In the general procedure, a mixture of potassium tetracarbonylhydridoferrate (11mmol), an amine(11mmol), an aldehyde or a ketone(22-33mmol), and ethanol(30-40ml) was stirred for 24-48 hr at room temperature under carbon monoxide. Products were identified by glpc analyses and by means of infrared spectra.

Some representative results are listed in Table. The technique is quite simple and gives excellent yields. The reaction proceeded smoothly with an absorption of carbon monoxide. Aniline was selectively converted into the corresponding N,N-dialkylaniline. With formaldehyde, N,N-dimethylation of aniline readily occurred via N-methylaniline. This procedure appears to be highly effective for N-methylation of aromatic amines.[3)] N,N-Ethylmethylaniline was

TABLE. THE SELECTIVE N,N-DIALKYLATION OF AMINES a)

Exp. No.	Amine	Carbonyl Compound	CO Absorbed b)	Amines a)	Yield c) (%)
1	Aniline	Formaldehyde	2.6	N,N-Dimethylaniline	∿100
2	Aniline	Acetaldehyde	1.9	N,N-Diethylaniline	∿100
3	Aniline	Propionaldehyde	1.7	N,N-Dipropylaniline	∿100
4	Aniline	Butyraldehyde	1.8	N,N-Dibutylaniline	∿100
5	Aniline	Benzaldehyde	1.3	N,N-Dibenzylaniline	85
6 d)	Aniline	Formaldehyde-Acetaldehyde	1.7	N,N-Ethylmethylaniline	∿100
7	N-Ethylaniline	Formaldehyde	1.7	N,N-Ethylmethylaniline	∿100
8	N-Methylaniline	Acetaldehyde	1.7	N,N-Ethylmethylaniline	∿100
9	Benzylamine	Formaldehyde	1.9	Benzyldimethylamine	∿100
10	Benzylamine	Acetaldehyde	1.2	Benzyldiethylamine	91

a) At 28-33°C for 24-48 hr.

b) Mole per mole of carbonylferrate used.

c) Determined by glpc using internal standards or by isolation.

d) At first with formaldehyde for 24 hr and then with acetaldehyde.

obtained when aniline was treated in two stages at first with formaldehyde and then with acetaldehyde. Benzylamine was also converted into the corresponding dialkylbenzylamine.

This reaction is also useful for N-monoalkylation 2) and the procedure may be efficiently conducted by the mole ratio, mole of a carbonyl compound per mole of an amine used; the mole ratios, 1 : 1 and 2 or more : 1, are effective for N-monoalkylation and for N,N-dialkylation, respectively. Thus principal advantage is that this method is widely applied for N-mono- and N,N-dialkylation of primary amines using a variety of carbonyl compounds and for the synthesis of tertiary amines with three different alkyls.

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3) N-Methylation of aromatic amines has been of interest. See A. Crochet, Jr. and C. B. Blantan, Jr., Synthesis, 1974, 55. References cited therein.

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