



A Publication
of Reliable Methods
for the Preparation
of Organic Compounds

Working with Hazardous Chemicals

The procedures in *Organic Syntheses* are intended for use only by persons with proper training in experimental organic chemistry. All hazardous materials should be handled using the standard procedures for work with chemicals described in references such as "Prudent Practices in the Laboratory" (The National Academies Press, Washington, D.C., 2011; the full text can be accessed free of charge at http://www.nap.edu/catalog.php?record_id=12654). All chemical waste should be disposed of in accordance with local regulations. For general guidelines for the management of chemical waste, see Chapter 8 of Prudent Practices.

In some articles in *Organic Syntheses*, chemical-specific hazards are highlighted in red "Caution Notes" within a procedure. It is important to recognize that the absence of a caution note does not imply that no significant hazards are associated with the chemicals involved in that procedure. Prior to performing a reaction, a thorough risk assessment should be carried out that includes a review of the potential hazards associated with each chemical and experimental operation on the scale that is planned for the procedure. Guidelines for carrying out a risk assessment and for analyzing the hazards associated with chemicals can be found in Chapter 4 of Prudent Practices.

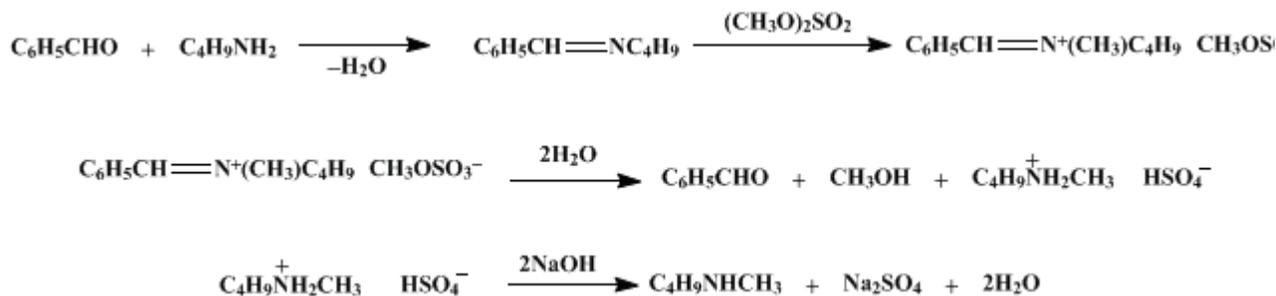
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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

Organic Syntheses, Coll. Vol. 5, p.736 (1973); Vol. 44, p.72 (1964).

N-METHYLBUTYLAMINE

[Butylamine, N-methyl-]



Submitted by John J. Lucier, Arlo D. Harris, and Philip S. Korosec¹.

Checked by Max Tishler and M. Bennett.

1. Procedure

A 1-l. round-bottomed flask fitted with a reflux condenser bearing a soda-lime drying tube is successively charged with 100ml. of anhydrous benzene, 36.6 g. (0.50 mole) of *n*-butylamine, and 63.7 g. (61 ml., 0.60 mole) of benzaldehyde (Note 1). The mixture is heated under reflux for 30 minutes (Note 2). The condenser is replaced by a Claisen distillation head, and the mixture is distilled until the temperature reaches 100° (Note 3). The residue, which is mostly *N*-benzylidenebutylamine, is cooled, and the distillation head is replaced by the reflux condenser bearing a soda-lime drying tube.

A solution of 75.6 g. (57 ml., 0.60 mole) of dimethyl sulfate (*Toxic!* (Note 4)) in 200 ml. of anhydrous benzene is added through the condenser with intermittent swirling (Note 2). The mixture is then heated gently. After a short period (about 10 minutes) the reaction becomes mildly vigorous, and the heating is stopped (Note 5). The ebullition subsides after about 10 minutes. The mixture is heated under reflux for 30 minutes. It is then steam-distilled until the distillate becomes clear; about 500 ml. of distillate is collected (Note 6). The residue is cooled in an ice bath, and 60 g. (1.5 moles) of sodium hydroxide is added with continuous swirling. The layers are separated, and the amine layer is dried for several hours over 5 g. of sodium hydroxide. The amine layer is separated, dried over a second 5-g. portion of sodium hydroxide (Note 7), and distilled from a 50-ml. Claisen flask containing 2 g. of sodium hydroxide. *N*-Methylbutylamine is collected at 86–90° (745 mm.); weight 19.6–23.0 g. (45–53%); *n*²⁰_D 1.4010–1.4020. The product contains 3–5% of impurity according to vapor-phase chromatographic analysis.

2. Notes

1. The benzaldehyde and *n*-butylamine were obtained from the Eastman Kodak Company (white label grade). The benzaldehyde was used without further purification. The *n*-butylamine was redistilled before use.

The checkers dried benzene over sodium-lead alloy (dri-Na, Baker). Its water content was less than 0.1 mg. per ml. by Karl Fischer titration.

2. The checkers stirred the mixture with a magnetic stirrer.

3. This distillation is carried out to remove the water formed by the first reaction. No more water comes over after the temperature reaches 100°. Toward the end of distillation, slight bumping may occur.

4. The dimethyl sulfate was purchased from Matheson, Coleman and Bell and was used without further purification. Both the liquid and the vapors of dimethyl sulfate are *toxic*, and the compound must be handled with care.

5. An ice bath should be kept ready to restrain the reaction if necessary.

6. In a simpler alternative to steam distillation, 200 ml. of water is added to the benzene solution, and the mixture is vigorously stirred under gentle reflux for 20 minutes. The mixture is cooled to room

temperature. The aqueous layer is separated, extracted with 100 ml. of ether to remove traces of benzaldehyde, and then treated with 60 g. of sodium hydroxide as in the present procedure.²
7. If a larger portion of sodium hydroxide is used, a semisolid mass is formed from which the product can be separated only with difficulty.

3. Discussion

Unsymmetrical secondary aliphatic amines have been prepared by reaction of alkyl halides with benzylidene amines and subsequent hydrolysis;^{3,4} by reaction of alkyl halides with alkyl amines;⁵ by reduction of amine-aldehyde adducts;^{6,7,8} and by dealkylation of tertiary amines with dibenzoyl peroxide.⁹

In the present procedure, the method of Decker and Becker³ has been modified by substitution of a dialkyl sulfate for the corresponding alkyl halide.

4. Merits of the Preparation

The procedure is a general one for the preparation of unsymmetrical aliphatic amines, for the submitters have used it to obtain good yields of N-methylpentylamine, N-methylhexylamine, N-methylheptylamine, N-ethylbutylamine, N-ethylpentylamine, and N-ethylheptylamine.

Compared to the procedure of Decker and Becker³ and that of Wawzonek, McKillip, and Peterson in this volume,⁴ the present procedure has the advantages of being simpler and using cheaper alkylating agents. It tends to give lower yields and less pure products than the procedure of Wawzonek, McKillip, and Peterson.

This preparation is referenced from:

- [Org. Syn. Coll. Vol. 5, 758](#)

References and Notes

1. Department of Chemistry, University of Dayton, Dayton, Ohio. This work was supported by Wright Air Development Division of the United States Air Force, Air Research and Development Command, under Contract No. AF 35(616)-6607.
2. C. L. Dickinson (E. I. du Pont de Nemours and Co.), private communication.
3. H. Decker and P. Becker, *Ann.*, **395**, 362 (1913).
4. S. Wawzonek, W. McKillip, and C. J. Peterson, *this volume*, p. 758.
5. O. Westphal and D. Jerchel, *Ber.*, **73B**, 1002 (1940).
6. H. Henze and D. Humphreys, *J. Am. Chem. Soc.*, **64**, 2878 (1942).
7. K. Campbell, A. Sommers, and B. Campbell, *J. Am. Chem. Soc.*, **66**, 82 (1944).
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9. L. Horner and W. Kirmse, *Ann.*, **597**, 48 (1955).

Appendix

Chemical Abstracts Nomenclature (Collective Index Number); (Registry Number)

[Benzene](#) (71-43-2)

[ether](#) (60-29-7)

sodium hydroxide (1310-73-2)

dimethyl sulfate (77-78-1)

benzaldehyde (100-52-7)

n-butylamine (109-73-9)

dibenzoyl peroxide (94-36-0)

sodium-lead

N-Methylbutylamine,
Butylamine, N-methyl- (110-68-9)

N-benzylidenebutylamine

amine-aldehyde (14332-28-6)

N-methylpentylamine (25419-06-1)

N-methylhexylamine (35161-70-7)

N-methylheptylamine (36343-05-2)

N-ethylbutylamine (13360-63-9)

N-ethylpentylamine

N-ethylheptylamine