



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.

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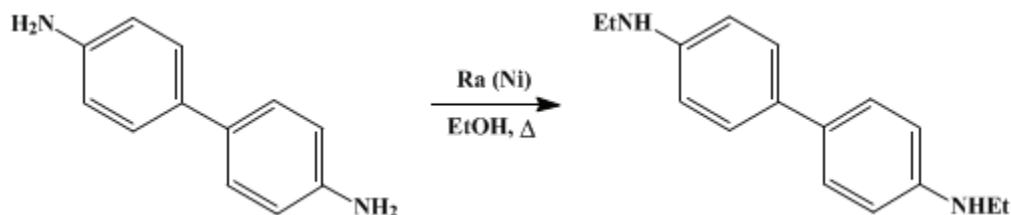
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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

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N,N'-DIETHYLBENZIDINE

[Benzidine, N,N'-diethyl-]



Submitted by Rip G. Rice and Earl J. Kohn¹.

Checked by Max Tishler, W. H. Jones, and W. F. Benning.

1. Procedure

In a 5-l. three-necked flask, fitted with an efficient stirrer (Note 1), a stopper, and a reflux condenser, are placed, in order, 184.2 g. (1 mole) of benzidine (Note 2), 500 ml. of commercial absolute ethanol, about 125 g. of Raney nickel,² and 500 ml. of ethanol. The mixture is heated under reflux with stirring for a total of 15 hours (Note 3). The volume is brought to 3 l. with 95% ethanol, and about 150 g. of filter aid ("Super-Cel") is added with stirring. The mixture is heated to boiling, filtered rapidly through a ¼-in. layer of filter aid on a Büchner funnel into a 4-l. filter flask (Note 4) and (Note 5), and the nickel is washed well with hot 95% ethanol (Note 6). The filtrate is concentrated to a volume of 1.5 l., cooled slowly to room temperature, then chilled in a refrigerator and filtered. The yield is 185–202 g. (77–84%) of light gray or purplish gray flakes, m.p. 105–115°.

The crude product is dissolved in 1.5 l. of hot 95% ethanol, the solution is treated with 5 g. of activated carbon, and the mixture is filtered rapidly with suction. The filtrate is made up to 1.5 l. with 95% ethanol and heated to dissolve the solid. The solution is allowed to cool slowly to room temperature, then chilled in a refrigerator and filtered. The yield is 143–161 g. (60–67%) of colorless flakes melting at 115–116° (Note 7).

2. Notes

- Efficient stirring is necessary to keep the nickel uniformly distributed throughout the reaction mixture; otherwise, the yield is decreased considerably.
- The submitters used benzidine obtained by neutralization of an aqueous solution of C.P. benzidine dihydrochloride (Matheson, Coleman and Bell) with 20% sodium hydroxide solution, followed by crystallization from 60–70% ethanol. The benzidine prepared in this manner was in the form of light tan flakes. Freshly prepared benzidine should be used for the best results.
- The refluxing time does not have to be continuous. The submitters heated the reaction mixture for 7 hours, allowed the mixture to stand overnight, and continued the refluxing the next day.
- This operation should be carried out in a well-ventilated hood.
- To prevent clogging of the Büchner funnel during filtration it is necessary to preheat the funnel and keep it hot during filtration.
- The nickel is pyrophoric and must be kept moist to prevent spontaneous ignition.
- The method has been applied successfully by the submitters³ to the preparation of N,N'-dibutylbenzidine (61% crude yield), N-ethyl-, N-propyl-, N-butyl-, N-amyl-, and N-benzylanilines (80–84% yields), N-hexylaniline (72%), and N-isobutyl- and N-isoamylanilines (41, 49%). N-Propylbutylamine was obtained from propyl alcohol and butylamine in 57% yield. The submitters state that no alkylation of benzidine took place with methyl alcohol or of aniline with methyl, isopropyl, or *sec*-butyl alcohol. The method has been applied to the synthesis of other N-alkyl and N-cycloalkyl aromatic amines.^{4,5}

3. Discussion

N,N'-Diethylbenzidine has been prepared by heating ethyl iodide, benzidine, and ethanol in a pressure tube at water-bath temperature,^{6,7} and by the reaction of diethylzinc on benzene-diazonium chloride.⁷ The method described here is a modification of that of Shah, Tilak, and Venkataraman.⁸

References and Notes

1. Naval Research Laboratory, Washington, D. C.
 2. *Org. Syntheses Coll. Vol. 3*, 181 (1955).
 3. Rice and Kohn, *J. Am. Chem. Soc.*, **77**, 4052 (1955).
 4. Ainsworth, *J. Am. Chem. Soc.*, **78**, 1636 (1956).
 5. Kao, Tilak, and Venkataraman, *J. Sci. Ind. Research India*, **14B**, 624 (1955).
 6. Hofmann, *Ann.*, **115**, 365 (1860).
 7. Bamberger and Tichvinsky, *Ber.*, **35**, 4179 (1902).
 8. Shah, Tilak, and Venkataraman, *Proc. Indian Acad. Sci.*, **28A**, 145 (1948).
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Appendix Chemical Abstracts Nomenclature (Collective Index Number); (Registry Number)

methyl, isopropyl, or sec-butyl alcohol

ethanol (64-17-5)

methyl alcohol (67-56-1)

aniline (62-53-3)

sodium hydroxide (1310-73-2)

benzene-diazonium chloride

nickel,
Raney nickel (7440-02-0)

carbon (7782-42-5)

propyl alcohol (71-23-8)

N-hexylaniline (4746-32-1)

N-Propylbutylamine (20193-21-9)

Butylamine (109-73-9)

diethylzinc (557-20-0)

benzidine (92-87-5)

Ethyl iodide (75-03-6)

benzidine dihydrochloride

N,N'-DIETHYLBENZIDINE,
Benzidine, N,N'-diethyl- (6290-86-4)

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