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.

The procedures described in *Organic Syntheses* are provided as published and are conducted at one's own risk. *Organic Syntheses, Inc.*, its Editors, and its Board of Directors do not warrant or guarantee the safety of individuals using these procedures and hereby disclaim any liability for any injuries or damages claimed to have resulted from or related in any way to the procedures herein.

*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.*
1. Procedure

One kilogram (16.4 moles) of ice-cold ethanolamine (Note 1) is added, through a dropping funnel, with mechanical stirring, to 7 l. (9.94 kg., 52 moles) of ice-cold hydrobromic acid (sp. gr. 1.42) (Note 2) contained in a 12-l. round-bottomed flask. The flask is attached to an efficient fractionating column and heated until 1850 cc. of distillate has been collected. The rate of heating is then diminished to a point at which the liquid ceases to distil and merely refluxes. The heating under reflux is continued for one hour. At the end of this time, 700 cc. more is distilled, and the solution is again heated under reflux for one hour. This procedure is followed with 600-, 300-, 250-, 150-, 100-, and 50-cc. portions of distillate. The process may be interrupted at any time. The solution is finally heated under reflux for three hours, and 2.3 l. of crude hydrobromic acid distilled. The total volume of distillate, including that which is collected during refluxing, must not be less than 6270 cc. or more than 6330 cc.

The dark-colored residue is divided into two approximately equal portions, and each is poured, while still hot, into a 4-l. beaker. After the liquid has cooled to about 70°, 1650 cc. of acetone is added to each portion. The mixture is stirred well, so that as much as possible of the dark-colored solid is brought into contact with the acetone. After standing in the icebox overnight, the β-bromoethylamine hydrobromide is collected on a filter, washed with acetone until colorless (Note 3), and air-dried for about fifteen minutes. The filtrates are combined, concentrated to a volume of 1 l., and cooled. After seeding, a second crop of nearly pure material is obtained. By evaporation to a syrup, cooling, and seeding, a third crop of slightly colored material is obtained. (Note 4). The yield is about 2.8 kg. (83 per cent of the theoretical amount) (Note 5).

2. Notes

1. Commercial ethanolamine is fractionated in a glass apparatus, and the fraction boiling at 167–169° is used.
2. The hydrobromic acid must have a specific gravity of at least 1.42.
3. It may be advisable for effective washing to transfer the crude cake to a mortar and crush it.
4. All three crops are suitable for use in the synthesis of taurine described on p. 564.
5. The procedure has been applied to the preparation of the following β-dialkylaminoethyl bromide hydrobromides.

<table>
<thead>
<tr>
<th>R</th>
<th>Yield, Per Cent</th>
<th>Heating Periods</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH₃</td>
<td>83</td>
<td>1–1.5 hr., 2 hr.</td>
</tr>
<tr>
<td>C₂H₅</td>
<td>80</td>
<td>1 hr., 2 hr.</td>
</tr>
<tr>
<td>n-C₃H₇</td>
<td>55</td>
<td>0.75 hr., 2 hr.</td>
</tr>
<tr>
<td>n-C₄H₉</td>
<td>20</td>
<td>1 hr., 3 hr.</td>
</tr>
<tr>
<td>n-C₅H₁₁</td>
<td>59</td>
<td>0.5 hr., 2 hr.</td>
</tr>
</tbody>
</table>
The final distillation was not always carried as far as called for by the procedure of Cortese. If a faint brown or violet color appeared in the distillate, or if white fumes were given off, the distillation was discontinued; further distillation seemed to cause decomposition. However, the color always came near the end point specified in the procedure above and the total volume of the distillates was never less than 95 per cent of that called for. Since the solubilities of the products in acetone range from very slight to extreme as the molecular weights increase, the extraction of the products requires variations in the amounts of acetone specified above. [Lawrence H. Amundsen and Karl W. Krantz, private communication, and J. Am. Chem. Soc. 63, 305 (1941).]

3. Discussion

β-Bromoethylamine hydrobromide has been prepared by the reaction of potassium phthalimide with ethylene bromide, followed by hydrolysis; by the addition of hydrogen bromide to ethyleneimine; from ethanolamine and hydrobromic acid; and from ethanolamine and hydrogen bromide at 140–190°. The preparation from ethyleneimine and hydrogen bromide is reported to succeed only if the imine is added to the acid.

This preparation is referenced from:


References and Notes

1. Gabriel, Ber. 21, 566 (1888).
2. Gabriel, ibid. 21, 1054 (1888); Gabriel and Stelzner, ibid. 28, 2929 (1895).

Appendix

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

- bromide (24959-67-9)
- HYDROBROMIC ACID, hydrogen bromide (10035-10-6)
- acetone (67-64-1)
- Potassium Phthalimide (1074-82-4)
- ethylene bromide (106-93-4)
- β-Bromoethylamine hydrobromide, Ethylamine, 2-bromo-, hydrobromide (2576-47-8)
- ethanolamine (141-43-5)
Taurine (107-35-7)

ethyleneimine (9002-98-6)