



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.

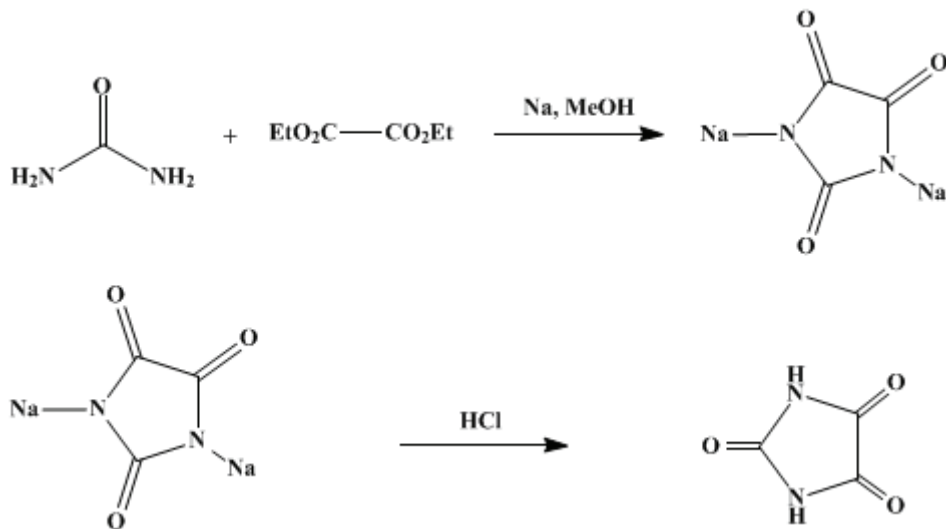
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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

Organic Syntheses, Coll. Vol. 4, p.744 (1963); Vol. 37, p.71 (1957).

PARABANIC ACID



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Checked by M. S. Newman and Tadamichi Fukunaga.

1. Procedure

Eight hundred fifty milliliters of absolute [methanol](#) (magnesium-dried) is distilled directly, through a condenser, into a 1-l. three-necked reaction flask equipped with a sealed mechanical stirrer and an efficient reflux condenser protected by a drying tube. After about 300 ml. of [methanol](#) has been distilled, the drying tube is removed from the reflux condenser, and small pieces of clean [sodium](#) are added to the stirred [methanol](#) at such a rate that the alcohol vapors do not escape from the condenser ([Note 1](#)). When a total of 23 g. (1 g. atom) of [sodium](#) has been added, the drying tube is replaced, the distillation of [methanol](#) is completed ([Note 1](#)), and the system is brought to a temperature of 20–25° (other temperatures are less favorable). The inlet condenser is removed, 30 g. (0.5 mole) of dry finely ground [urea](#) ([Note 2](#)) is quickly added to the reaction mixture, and the opening is then closed by attaching a dropping funnel. When the [urea](#) has dissolved completely, the addition of 70 g. (0.48 mole) of [diethyl oxalate](#) ([Note 2](#)) is begun ([Note 3](#)). A white precipitate forms immediately. Stirring is continued for 1 hour after the addition of the ester has been completed ([Note 4](#)). One hundred milliliters of concentrated [hydrochloric acid](#) is added dropwise to the mixture at a rate that causes little increase in the solution temperature, stirring is continued for a few minutes, and the mixture is filtered. The residue is washed twice with a small quantity of [methanol](#), and the filtrate and washings are transferred to a 2-l. two-necked flask equipped with a sealed stirrer and a vacuum take-off. The alcohol is removed under the reduced pressure of a good water aspirator ([Note 5](#)). The practically dry solid residue is washed from the evaporator with water which is used as the recrystallization solvent ([Note 6](#)). When the bulk of the solid has dissolved, the solution is cooled slightly below the boiling point, 2 g. of activated [carbon](#) is added, and the solution is filtered through a hot Büchner funnel by use of moderate suction. The solution yields a white, crystalline precipitate of [parabanic acid](#) upon standing in a refrigerator overnight. The yield of purified, dried product melting at 241–243° with decomposition is 39–41.5 g. (71.5–76%).

2. Notes

1. The checkers used Mallinckrodt analytical reagent [methanol](#) without drying and distilling. The [sodium](#) was added to 300 ml. of the [methanol](#), and the remainder of the [methanol](#) was added dropwise. The results obtained in this way were the same as those described by the submitter. The [hydrogen](#) released during the formation of the [sodium methoxide](#) prevents moisture from entering

the system. More rapid addition of the sodium and reduced loss of methanol vapor are realized if the reaction flask is surrounded by an ice bath during the addition of the metal. Calcium chloride should not be used in the drying tube because of possible clogging. Drierite (CaSO_4) is preferable.

2. The checkers used reagent grade urea (Baker) and diethyl oxalate (Matheson, Coleman and Bell), without purification.

3. Ester addition must be quite slow (2 drops per second or less) to prevent emulsion formation and extremely low yields.

4. At the end of 1 hour, the precipitated salt should be in a fine crystalline form which settles readily when the stirring is momentarily stopped. A viscous, creamy suspension which is poorly mixed by the stirring usually gives poor yields. Factors contributing to this condition have been found to be: insufficient amount of solvent initially, too rapid addition of ester, and improper temperature control.

5. Considerable frothing may be encountered during the first stages of the evaporation, particularly when a steam bath is used to hasten removal of the solvent. Rapid stirring helps to cut down frothing and lessens bumping.

6. The solid may go into solution rather slowly even in boiling water.

3. Discussion

Parabanic acid can be prepared by the condensation of urea with diethyl oxalate in an ethanolic solution of sodium ethoxide,² by reaction of urea with an ethereal solution of oxalyl chloride,³ by oxidizing uric acid with an acid solution of perhydrol,⁴ or by the action of hot, concentrated nitric acid on uric acid.⁵ The present method gives better yields than the previously reported methods and is better adapted to larger-scale preparations.

References and Notes

1. University of Buffalo, Buffalo, New York.
2. Michael, *J. prakt. Chem.*, [2]35, 457 (1886).
3. Biltz and Topp, *Ber.*, 46, 1387 (1913).
4. Biltz and Schiemann, *Ber.*, 59, 721 (1926).
5. Behrend and Asche, *Ann.*, 416, 226 (1918).

Appendix

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

Perhydrol

Drierite (CaSO_4)

ethanolic solution of sodium ethoxide

calcium chloride (10043-52-4)

hydrochloric acid (7647-01-0)

methanol (67-56-1)

hydrogen (1333-74-0)

nitric acid (7697-37-2)

sodium methoxide (124-41-4)

carbon (7782-42-5)

sodium (13966-32-0)

urea (57-13-6)

uric acid

oxalyl chloride (79-37-8)

diethyl oxalate (95-92-1)

Parabanic acid (120-89-8)