



A Publication
of Reliable Methods
for the Preparation
of Organic Compounds

Working with Hazardous Chemicals

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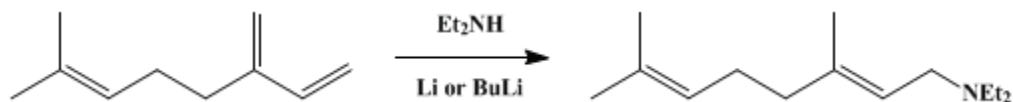
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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

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ADDITION OF DIALKYLAMINES TO MYRCENE: *N,N*-DIETHYLGERANYLAMINE

[2,6-Octadien-1-amine, *N,N*-diethyl-3,7-dimethyl-, (*E*)-]



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Checked by Alan J. Chalk, Laszlo V. Wertheimer, and Gabriel Saucy.

1. Procedure

In a 50-mL, round-bottomed glass reactor equipped with a magnetic stirring bar are placed 13.60 g (74 mmol) of myrcene (Note 1), 10.29 g (141 mmol) of diethylamine (Note 2), and 0.185 g (0.0267 g-atom) of metallic lithium cut into small pieces. The vessel is flushed with dry nitrogen, and is sealed. The solution is heated to 55°C in a water bath, and is stirred for 5 hr. The vessel is cooled to room temperature and the contents are poured into 30 mL of ice-water. The upper organic layer is separated, and the aqueous layer is extracted with 20-mL portions of diethyl ether. The combined organic layer is washed with aqueous sodium sulfate solution, dried over anhydrous sodium sulfate, and evaporated under reduced pressure. Distillation (Note 3) of the residual liquid affords 1.2–2.0 g of unreacted myrcene and 12.66–13.28 g (74–77%) of the product as a colorless liquid, bp 67–68°C (0.5 mm). GLC analysis indicated that the product contained 91.2–92.5% of *N,N*-diethylgeranylamine and other isomers (Note 4).

The checkers found that the use of benzene (20 mL) as a solvent increased the selectivity for *N,N*-diethylgeranylamine to 94% (Note 5) and (Note 6).

A similar reaction of myrcene with dipropylamine (50°C, 20 hr) afforded *N,N*-dipropylgeranylamine (80%; bp 93–94°C, 1 mm).

2. Notes

1. Myrcene, obtained from SCM Organic Chemicals (also available from Takasago Perfumery Company, Ltd., in Japan), was distilled (bp 69–70°C, 20 mm) prior to use. GLC analysis (Triton X-305, 0.28 mm × 30 m, 80–120°C) showed that the fraction contained 74% myrcene. The submitters used 80% pure myrcene.
2. Diethylamine, obtained from Aldrich Chemical Company, Inc. (also available from Nakarai Chemicals, Ltd., in Japan), was distilled from calcium hydride before use.
3. A short-path distillation apparatus was used in order to prevent loss of the product.
4. GLC analysis (Triton X-305; 0.28 mm × 30 m, 80–160°C) showed a composition of 92% *N,N*-diethylgeranylamine and other isomers that were identified by the checkers.³ The spectral properties of *N,N*-diethylgeranylamine are as follows: IR (neat) cm⁻¹: 1660, 1200, 1165, 1050, 830; ¹H-NMR (CDCl₃, 60 MHz) δ: 0.96 (t, 6 H, *J* = 7), 1.44–1.67 (m, 6 H), 1.85–2.15 (m, 4 H), 2.40 (q, 4 H, *J* = 7), 2.92 (d, 2 H, *J* = 6.5), 4.77–5.30 (m, 2 H).
5. The submitters preferred butyllithium in hexane in place of lithium metal. In a 50-mL, round-bottomed flask equipped with a magnetic stirring bar are placed 4.08 g (24 mmol) of myrcene and 3.29 g (45 mmol) of diethylamine under nitrogen. The mixture is cooled to 0°C using an ice bath, and 3.0 mL (4.8 mmol) of a 1.60 *M* solution of butyllithium in hexane is added dropwise by syringe while stirring for 15 min. The flask is sealed, and the solution is warmed to 50°C and stirred for 4 hr. The vessel is cooled to room temperature, and the contents are poured into 20 mL of cold water. The vessel is washed with 30 mL of diethyl ether and 10 mL of water. The upper layer is separated and the aqueous layer is extracted twice with 20 mL of diethyl ether. The combined organic layers are washed with brine, dried

over anhydrous sodium sulfate, and evaporated under reduced pressure. Distillation (Note 3) of the residual liquid affords a 0.31–0.42-g forerun of unreacted myrcene and 4.06–4.37 g of the product (77–83%) as a colorless liquid, bp 84–86°C (1.5); composition by GLC: 95.3% *N,N*-diethylgeranylamine and 4.5% other isomers.

6. The submitters report that sodium naphthalenide can be used in place of butyllithium. Using tetrahydrofuran as a solvent, they obtained *N,N*-diethylgeranylamine in 56% yield.

3. Discussion

N,N-Dialkylgeranylamines have been prepared by the reaction of dialkylamines with geranyl halides.^{4,5} The procedure described here is a modification of one we reported earlier.^{4,6} It is a simple, one-step synthesis of *N,N*-dialkylgeranylamines from myrcene and dialkylamines, which are readily available bulk chemicals. The reaction proceeds stereoselectively, and yields are high.

N,N-Diethylgeranylamine is a key intermediate for the synthesis of industrially important acyclic monoterpenes such as geranyl acetate,⁷ linalool,⁸ citral,⁹ and citronellal.¹⁰

This preparation is referenced from:

- Org. Syn. Coll. Vol. 8, 183

References and Notes

1. Department of Synthetic Chemistry, Faculty of Engineering, Shizuoka University, Johoku, Hamamatsu 432, Japan.
2. Department of Applied Chemistry, Faculty of Engineering, Chiba University, Yayoicho, Chiba 280, Japan.
3. Chalk, A. J.; Magennis, S. A. *Ann. N.Y. Acad. Sci.* **1980**, *333*, 286–301.
4. Takabe, K.; Katagiri, T.; Tanaka, J. *Bull. Chem. Soc. Jpn.* **1973**, *46*, 222–225.
5. Rautenstrauch, V. *Helv. Chim. Acta* **1973**, *56*, 2492–2508.
6. Fujita, T.; Suga, K.; Watanabe, S. *Chem. Ind. (London)* **1973**, 231–232.
7. Fujita, T.; Suga, K.; Watanabe, S. *Aust. J. Chem.* **1974**, *27*, 531–535.
8. Takabe, K.; Katagiri, T.; Tanaka, J. *Tetrahedron Lett.* **1975**, 3005–3006.
9. Takabe, K.; Yamada, T.; Katagiri, T. *Chemistry Lett.* **1982**, 1987–1988.
10. Tani, K.; Yamagata, T.; Otsuka, S.; Akutagawa, S.; Kumobayashi, H.; Taketomi, T.; Takaya, H.; Miyashita, A.; Noyori, R. *J. Chem. Soc., Chem. Commun.* **1982**, 600–601.

Appendix

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

brine

MYRCENE

Benzene (71-43-2)

diethyl ether (60-29-7)

sodium sulfate (7757-82-6)

nitrogen (7727-37-9)

diethylamine (109-89-7)

lithium (7439-93-2)

butyllithium (109-72-8)

Tetrahydrofuran (109-99-9)

hexane (110-54-3)

citral (5392-40-5)

calcium hydride (7789-78-8)

Linalool (78-70-6)

citronellal (106-23-0)

geranyl acetate (105-87-3)

N,N-Diethylgeranylamine,
2,6-Octadien-1-amine, N,N-diethyl-3,7-dimethyl-, (E)- (40267-53-6)

sodium naphthalenide

dipropylamine (142-84-7)

N,N-dipropylgeranylamine