



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](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.

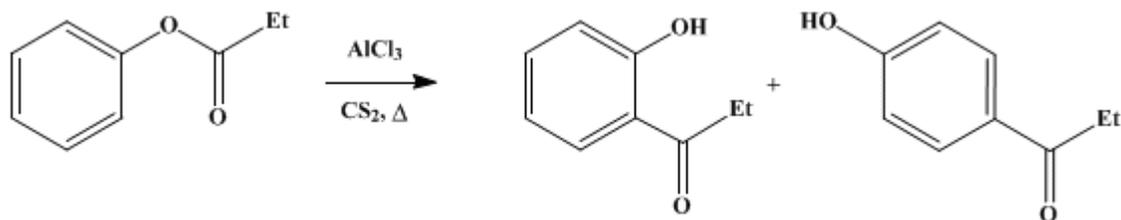
The procedures described in *Organic Syntheses* are provided as published and are conducted at one's own risk. *Organic Syntheses, Inc.*, its Editors, and its Board of Directors do not warrant or guarantee the safety of individuals using these procedures and hereby disclaim any liability for any injuries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

*Organic Syntheses, Coll. Vol. 2, p.543 (1943); Vol. 13, p.90 (1933).*

## *o*-PROPIOPHENOL AND *p*-PROPIOPHENOL

[Propiophenone, *o*- and *p*-hydroxy-]



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### 1. Procedure

In a 2-l. three-necked, round-bottomed flask, fitted with a reflux condenser, a mechanical stirrer (Note 1), and a 100-cc. dropping funnel, are placed 374 g. (2.8 moles) of anhydrous aluminum chloride and 400 cc. of carbon disulfide (Note 2). To the stirred suspension is added slowly through the dropping funnel 375 g. (2.5 moles) of phenyl propionate (Note 3). Reaction sets in almost at once with the evolution of hydrogen chloride (Note 4), and the carbon disulfide begins to reflux from the heat of reaction (Note 5). When all the propionate is in (one and one-half hours is required), the mixture is further heated to gentle refluxing on a steam bath until the evolution of hydrogen chloride has practically ceased (about two hours). The reflux condenser is then turned downward, and the carbon disulfide is distilled. The steam bath is replaced by an oil bath which is heated to 140° and maintained at 140–150° for three hours (Note 6). During this period a fresh evolution of hydrogen chloride takes place. The mixture thickens and finally congeals to a brown resinous mass. Stirring is continued as long as possible (Note 7).

The solid is then allowed to cool, and the aluminum complex is decomposed by slowly adding first a mixture of 300 cc. of concentrated hydrochloric acid with 300 cc. of water and then 500 cc. of water (Note 8), whereupon a black oil collects at the surface. After standing overnight in the ice box, a large portion of this layer solidifies and can be separated by filtration. This solid (*p*-propiophenol) is recrystallized from 400 cc. of methyl alcohol. The yield is 129–148 g. (34–39 per cent of the theoretical amount) of a light yellow product melting at 145–147°. A second recrystallization raises the melting point to 147–148°.

The oily filtrate combined with the concentrated mother liquors of the above recrystallization is dissolved in 500 cc. of 10 per cent sodium hydroxide and extracted with two 100-cc. portions of ether to remove non-phenolic products. The alkaline solution is acidified with hydrochloric acid and the oily layer is separated, dried over anhydrous magnesium sulfate, and distilled. The *o*-propiophenol boils at 110–115°/6 mm. The yield is 120–132 g. (32–35 per cent of the theoretical amount). About 40 g. of *p*-propiophenol boiling at 135–150°/11 mm. is obtained. The total yield of crude *p*-propiophenol is thus 169–188 g. (45–50 per cent of the theoretical amount) (Note 9).

### 2. Notes

1. The stirrer should be made of sturdy glass rod, bent preferably in the shape of a golf-club head, to provide for heavy duty when the reaction mass becomes thick.
2. When nitrobenzene was used as a solvent the products were always tarry.
3. Crude, undistilled phenyl propionate, made by gently heating a mixture of equivalent quantities of phenol and propionyl chloride until hydrogen chloride evolution ceases, is satisfactory for rearrangement. The ester can also be made conveniently by slowly adding one mole of thionyl chloride to a mixture of 1.05 moles each of phenol and propionic acid, driving off all the hydrogen chloride and

sulfur dioxide, and distilling.

4. Because of the large volume of hydrogen chloride evolved, it is desirable to work under a good hood. If this is not available, the gas-trap described on p. 4 may be used.

5. The addition of the phenyl propionate is regulated so as to maintain gentle refluxing.

6. The temperature of the reaction mixture is about ten degrees lower than the bath temperature, or 130–135°. The reaction temperature determines the yield ratio of the two isomers. In general, higher temperature (above 160–170°) favors the formation of the ortho isomer.

7. It is necessary to stir the thickening mass continuously to permit the escape of hydrogen chloride formed during the heating; otherwise it may swell rapidly and choke the outlets of the flask.

8. This decomposition is strongly exothermic, and the dilute acid should be added slowly.

9. The above procedure has been found satisfactory for the preparation of a number of the homologs of *o*- and *p*-propiophenol, such as aceto-, butyro-, and caprophenol.

### 3. Discussion

Ortho and para propiophenols have been previously prepared by condensing propionic acid and phenol in the presence of zinc chloride,<sup>1</sup> and from phenol and propionyl chloride.<sup>2</sup> The procedure described above is an adaptation of one described by Cox<sup>3</sup> and by Hartung, Munch, Miller, and Crossley.<sup>4</sup> In an alternative procedure phenyl propionate is added directly to aluminum chloride; no solvent is used.<sup>5</sup>

This preparation is referenced from:

- Org. Syn. Coll. Vol. 3, 387
- Org. Syn. Coll. Vol. 3, 444

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### References and Notes

1. Goldzweig and Kaiser, J. prakt. Chem. (2) **43**, 86 (1891).
2. Perkin, J. Chem. Soc. **55**, 547 (1889).
3. Cox, J. Am. Chem. Soc. **49**, 1028 (1927).
4. Hartung, Munch, Miller, and Crossley, *ibid.* **53**, 4153 (1931).
5. Farinholt, Harden, and Twiss, *ibid.* **55**, 3386 (1933).

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### Appendix

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

aceto-, butyro-, and caprophenol

Ortho and para propiophenols

*o*-PROPIOPHENOL

*p*-PROPIOPHENOL

Propiophenone, *o*- and *p*-hydroxy-

*o*- and *p*-Propiophenol

hydrogen chloride,

hydrochloric acid (7647-01-0)

methyl alcohol (67-56-1)

ether (60-29-7)

sodium hydroxide (1310-73-2)

thionyl chloride (7719-09-7)

phenol (108-95-2)

propionic acid (79-09-4)

sulfur dioxide (7446-09-5)

aluminum chloride (3495-54-3)

Nitrobenzene (98-95-3)

zinc chloride (7646-85-7)

magnesium sulfate (7487-88-9)

propionyl chloride (79-03-8)

carbon bisulfide

phenyl propionate (637-27-4)