



A Publication
of Reliable Methods
for the Preparation
of Organic Compounds

Working with Hazardous Chemicals

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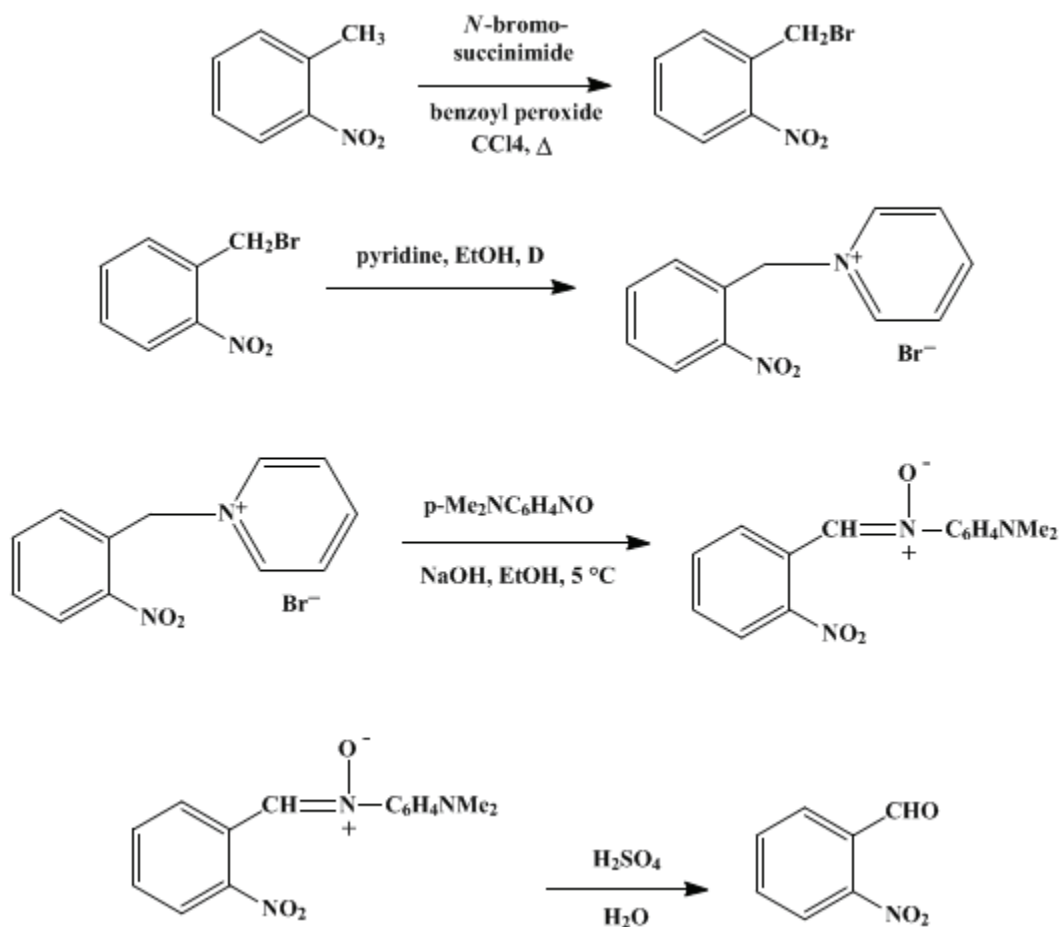
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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

Organic Syntheses, Coll. Vol. 5, p.825 (1973); Vol. 46, p.81 (1966).

***o*-NITROBENZALDEHYDE**

[Benzaldehyde, *o*-nitro-]



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1. Procedure

A. *o*-Nitrobenzylpyridinium bromide. A 1-l. flask fitted with a reflux condenser is charged with 102 g. (0.744 mole) of *o*-nitrotoluene, 120 g. (0.675 mole) of *N*-bromosuccinimide, 1.0 g. of benzoyl peroxide, and 450 ml. of dry carbon tetrachloride. The mixture is heated under reflux until, after the refluxing is temporarily interrupted, all the solid is seen to float on the surface (usually 6–8 hours suffices).

The hot mixture is filtered with suction into a 1-l. round-bottomed flask through a Büchner-type sintered glass funnel provided with a ground joint (Note 1). The solid on the funnel is washed successively with two 50-ml. portions of hot carbon tetrachloride. The solvent is removed from the filtrate under reduced pressure on a water bath (Note 2). The flask is then fitted with a reflux condenser, and 400 ml. of commercial absolute ethanol and 65 ml. (0.81 mole) of good grade pyridine (Note 3) are added to the residue.

The solution is heated at the reflux temperature for 45 minutes and immediately transferred to a wide-mouthed Erlenmeyer flask. Crystallization begins at once, and, after the mixture is cooled, the crystals of nearly pure *o*-nitrobenzylpyridinium bromide are collected, washed with cold ethanol, and

used in the next step (Note 4).

B. *N-(p-Dimethylaminophenyl)-α-(o-nitrophenyl)nitron*e. The wet *o*-nitrobenzylpyridinium bromide, together with 100 g. (0.536 mole) of *p*-nitrosodimethylaniline hydrochloride (Note 5) and 800 ml. of ethanol are introduced into a 2-l. three-necked flask equipped with an efficient stirrer, thermometer, and a dropping funnel, and immersed in an ice-salt bath. The stirrer is started, and a solution of 54 g. (1.35 mole) of sodium hydroxide in 500 ml. of water is added at 0–5° (Note 6). The color changes gradually from yellow to green, brown, and orange. The stirring is continued at 5–10° over a period of 1 hour. At the end of this time 500 ml. of ice-cold water is added to the flask, and the orange *N-(p-dimethylaminophenyl)-α-(o-nitrophenyl)nitron*e is collected on a large Büchner funnel, pressed well, and washed with cold water. The nitron is used in the next step without further purification (Note 7).

C. *o*-Nitrobenzaldehyde. The wet crude nitron is placed in a 3-l. beaker. A solution of approximately 6*N* sulfuric acid (Note 8), (Note 9) is then added, and the mixture is hand-stirred with a spatula or a glass rod. Crushed ice is added after 10 minutes, and the crude solid *o*-nitrobenzaldehyde is filtered, washed successively with dilute sodium bicarbonate solution and water, and dried over calcium chloride in a desiccator.

The light brown material is best purified by distillation under reduced pressure. The yellow aldehyde is collected at 120–140° (3 mm.) (Note 10) and melts at 41–44°. This material weighs 48–54 g. (47–53% overall yield based on *N*-bromosuccinimide) and is sufficiently pure for most uses (Note 11), (Note 12).

2. Notes

1. Suction filtration is necessary. The filtration is conveniently carried out through a regular Büchner funnel connected through a rubber stopper to a 1-l. suction flask. *Since o-nitrobenzyl bromide is a powerful lachrymator, the filtration should be carried out in a fume hood.*
2. The checkers used a rotary evaporator.
3. The checkers used Merck Reagent A.C.S. grade pyridine.
4. The yield of air-dried *o*-nitrobenzylpyridinium bromide is 125–135 g. (63–68%). The product melts at 206–208° (cor.).
5. Freshly prepared *p*-nitrosodimethylaniline hydrochloride² was used without further purification.
6. Sometimes a difficulty in stirring is encountered, and 100–200 ml. of ethanol should be added to the reaction mixture. The checkers found that the reaction mixture became a very thick paste which was quite difficult to stir. Use of a sturdy Hershberg stirrer is recommended.
7. The wet material contains about 55–65% of water. When the product is dried in a vacuum desiccator and recrystallized from ethyl acetate or acetone, it melts at 130–134°.
8. The solution is prepared by careful addition of 170 ml. of concentrated sulfuric acid to 850 ml. of water.
9. Hydrochloric acid (15%) can be substituted for sulfuric acid with equal results.
10. The checkers collected the product at 97–99° (1 mm.).
11. Very pure material can be obtained by dissolving *o*-nitrobenzaldehyde in toluene and precipitating with petroleum ether, according to earlier instructions.³
12. The same yields are obtained when the scale of this preparation is doubled.

3. Discussion

o-Nitrobenzaldehyde has been prepared by numerous methods.³ The best-known and most widely used route involves the oxidation of *o*-nitrotoluene by chromium trioxide in acetic anhydride/acetic acid solution.³ The present preparation is an example of the Kröhnke reaction.⁴ It is adapted from the published directions for the synthesis of a series of halo- and nitrobenzaldehydes.⁵

4. Merits of the Preparation

The present procedure is a general method for preparing aromatic and heterocyclic aldehydes. It is

of particular value in the synthesis of *o*-nitrobenzaldehydes in 100–200 g. lots. The benzaldehydes are useful starting materials for cinnamic acids, β -nitrostyrenes, etc. The manipulations are simple, the yields are reproducible, and the intermediates can be easily isolated and purified. The intermediates themselves have many synthetic uses.

The submitter has prepared the fluoro-*o*-nitrobenzaldehydes shown in Table I by application of this method.⁶

TABLE I
FLUORO-*o*-NITROBENZALDEHYDES

Position of Fluorine	M. P. of Fluoro-2-nitrobenzylpyridinium Bromide, °C	M. P. of N-(<i>p</i> -dimethylaminophenyl)- α -(fluoro- <i>o</i> -nitrophenyl)nitron, °C	M. P. of Aldehyde, °C	Overall Yield, %
4	200–201	164–165	32–33	55–62
5	189–190	155–156	93–95	45–55
6	202–204	151–152	62–63	59–66

References and Notes

1. Israel Institute for Biological Research, Ness-Ziona, Israel.
2. G. M. Bennett and E. V. Bell, *Org. Syntheses*, Coll. Vol. 2, 223 (1943).
3. S. M. Tsang, E. H. Wood, and J. R. Johnson, *Org. Syntheses*, Coll. Vol. 3, 641 (1955).
4. F. Kröhnke, *Angew. Chem. Intern. Ed.*, 2, 380 (1963).
5. K. Clarke, *J. Chem. Soc.*, 3807 (1957).
6. A. Kalir and D. Balderman, *Israel J. Chem.*, 6, 927 (1968).

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

petroleum ether

ethanol (64-17-5)

calcium chloride (10043-52-4)

sulfuric acid (7664-93-9)

hydrochloric acid (7647-01-0)

ethyl acetate (141-78-6)

sodium hydroxide (1310-73-2)

sodium bicarbonate (144-55-8)

carbon tetrachloride (56-23-5)

acetone (67-64-1)

pyridine (110-86-1)

toluene (108-88-3)

o-nitrotoluene (88-72-2)

benzoyl peroxide (94-36-0)

chromium trioxide (1333-82-0)

o-Nitrobenzaldehyde,
Benzaldehyde, o-nitro- (552-89-6)

N-bromosuccinimide (128-08-5)

nitro

o-nitrobenzyl bromide (3958-60-9)

acetic anhydrideacetic acid

p-Nitrosodimethylaniline hydrochloride (42344-05-8)

o-Nitrobenzylpyridinium bromide (13664-80-7)

N-(p-Dimethylaminophenyl)- α -(o-nitrophenyl)nitro (13664-79-4)