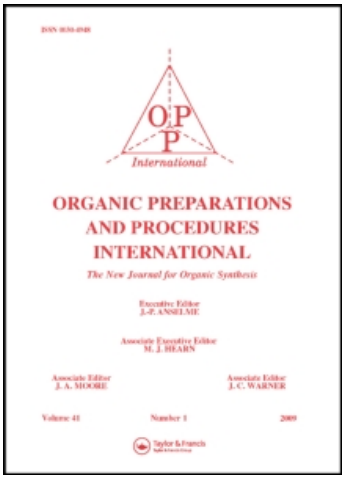

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A SIMPLE PREPARATION OF 4-AMINO-2,3,5-TRICHLOROPYRIDINE

C. S. Giam[a]; S. D. Abbott[a]; R. C. Hall[a]
[a] Department of Chemistry, Texas A&M University, College Station, Texas

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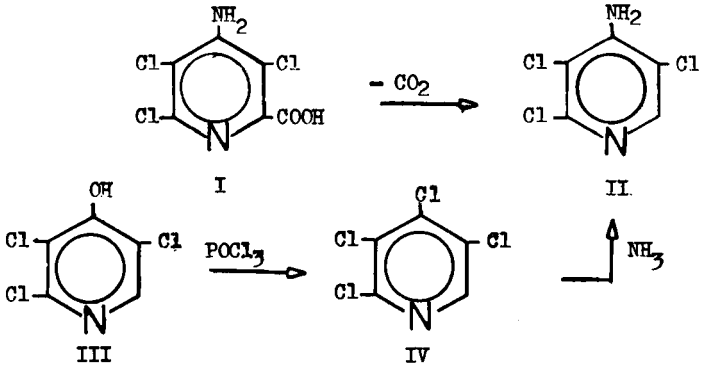
A SIMPLE PREPARATION OF 4-AMINO-2,3,5-TRICHLOROPYRIDINE

C. S. Giam[1], S. D. Abbott and R. C. Hall

Texas A&M University
Department of Chemistry
College Station, Texas 77843



A practical gas-chromatographic procedure[2,3] for the determination of the herbicide, 4-amino-2,3,5-trichloropicolinic acid (I) requires the title compound (II) for calibration purposes. (II) is not commercially available and the preparative methods which have been reported[4,5] required sealed-tube reactions, high temperatures and starting materials which are not readily accessible. We have investigated several ways (Methods 1-5) of preparing (II) from 4-amino-2,3,5-trichloropicolinic acid (I) which is commercially available (Picloram[6]).

The first procedure involved the decarboxylation of picloram in a glass-tube furnace at 385° and in the presence of wet ether. Although the yield was satisfactory, the use of highly inflammable ether was not desirable. Consequently, a solution of picloram in aqueous ammonium hydroxide was used instead (Method 2). A simple but crude decarboxylation

(Method 3) was also observed by heating picloram to its melting point. Finally, (II) was obtained by gently boiling a solution of picloram in dimethylformamide and trifluoroacetic acid. The latter method (Method 4) is recommended for preparing (II).

An authentic smaple of (II) may be prepared by an alternate route (Method 5). The commercially available Daxtron[7], 2,3,5-trichloro-4-pyridone (III), when treated with phosphorus oxychloride and dimethylformamide gave 2,3,4,5-tetrachloropyridine (IV) which on ammonolysis yielded (II). Compound II thus obtained was identical to the product obtained by the decarboxylation of picloram. Their physical properties, IR, NMR and high resolution mass spectra were consistent with the assigned structure.

EXPERIMENTAL SECTION[8]

Decarboxylation of Picloram (I).

Method 1. A solution of picloram (0.405m mol) in 80ml of wet ether was introduced into a Vycor tube (1" x 3 ft.) via a syringe and a sage-pump, at a rate of 50 ml/hr. The Vycor tube was heated in a Lindberg furnace; the decarboxylation temperature was 385 ± 5°. Nitrogen flowing at 60 ml/min, was used as a carrier gas. The product (II) (0.061g, 70% yield), mp. 148-9° (lit.[4,5] mp. 147-8°) condensed as fine white needles in the first cool zone below the furnace. Precise m/e Calcd. for $C_5H_3N_2Cl_3$: 195·9358. Obs.: 195·9357.

Method 2. Picloram (0.201g) was dissolved in 10 ml. of conc. ammonium hydroxide and diluted with 23 ml. of water. This solution was introduced into the tube-furnace described above. Pure (II) (0.098, 60%) mp. 149-149.5° was again obtained in the cool zone below the furnace.

Method 3. A sample of picloram was gently heated in a test tube over a flame. Upon melting, it gave off carbon dioxide and an impure

residue of (II), mp. 142-6°, was obtained.

Method 4 Decarboxylation of Picloram in Solution. A solution of commercial sample of 93% picloram, (2g, 8.7mmole) dissolved in 70 ml. of DMF and 2 ml. of CF_3COOH was heated for 12 hrs. under gentle reflux. The reaction mixture was then cooled, and poured over cracked ice. The precipitated 4-amino-2,3,5-trichloropyridine was filtered, dissolved in ether. The ethereal solution was washed with 10% Na_2CO_3 and dried ($MgSO_4$) then passed through a column of neutral activated alumina. The ether was removed and the product, 4-amino-2,3,5-trichloropyridine, (II), (1.07g, 70% yield), mp. 149-149.5°, obtained after recrystallization from chloroform.

Method 5. Conversion of 2,3,5-trichloro-4-pyridine (Daxtron) to 4-amino-2,3,5-trichloropyridine (II). A mixture of 11.7g (0.059 mole) of Daxtron and 150 ml. of $POCl_3$ and 10 ml. of DMF was heated at gentle reflux for 2 hrs. After cooling, the reaction mixture was poured carefully over cracked ice. Upon complete hydrolysis of $POCl_3$ (the reaction mixture cleared), 2,3,4,5-tetrachloropyridine, (III) precipitated and was filtered. (Note: the reaction mixture must be cold during filtration, since 2,3,4,5-tetrachloropyridine melts at 21°). (III) was then dissolved in hexane and the solution was washed with water and dried ($MgSO_4$). The hexane solution was then passed through a column of neutral alumina to remove any unreacted starting material. The solvent was removed by vacuum distillation and the product, (10.1 g, 83% yield), mp. 21-22° (lit.[9] mp. 21-22°), obtained on recrystallization from aqueous methanol. The infrared spectrum (KBr) showed the following peaks: 2360, 1530, 1400, 1330, 1215, 1155, 1170, 1080, 915, 862, 775, 728, 610 cm^{-1}. The nmr (proton) spectrum (CCl_4) showed one signal δ (ppm) 8.31 (s).

The 2,3,4,5-tetrachloropyridine (10 g, 0.046 mole), prepared above,

was dissolved in absolute alcohol (600 ml) which had been saturated with ammonia at 0°C. The solution was heated in a closed tube at 140-50° for 24 hours. The tube was then cooled, and the contents poured into cracked ice. 4-Amino-2,3,5-trichloropyridine, (II), precipitated, and was filtered. It was dissolved in a mixture of ether and ethanol and passed through a column of alumina. The solvent was removed, and the product (II) (7.8 g, 85% yield), mp. 149-149.5° obtained after recrystallization from chloroform. (The infrared spectrum (KBr) showed the following peaks: 3495, 3485, 3520, 1630, 1580, 1480, 1310, 1280, 1200, 1100, 1070-1085, 940, 920, 815, 735, and 610 cm^{-1}. The nmr (proton) spectrum ($CDCl_3$) showed signals at δ (ppm) 8.04 (s,1) and 5.0-5.3 (broad, 2).)

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6. Picloram is the name accepted by the Weed Society of America; product of Dow Chemical Company.
7. A product of Dow Chemical Company.
8. Melting points are uncorrected. The IR spectra were obtained with either a Beckman IR8 or IR12 spectrometer. NMR spectra were ob-

obtained with a Varian HA 100 spectrometer; tetramethylsilane was used as an internal reference.

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