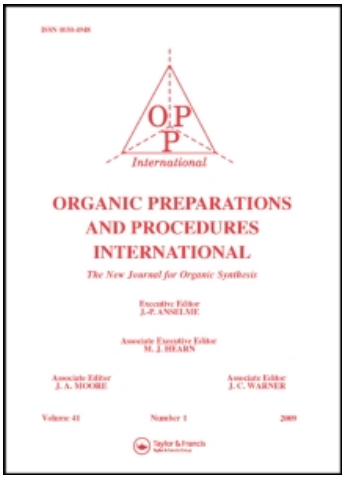


Organic Preparations and Procedures International
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t902189982

SIMPLE PREPARATION OF AMINOMETHANEPHOSPHONIC ACID

Jaroslav Kahovec[a]; František Ŝvec[a]; Milan Marhol[b]
[a] Czechoslovak Academy of Sciences, Institute of Macromolecular Chemistry, Prague 6, CZECHOSLOVAKIA [b] Nuclear Research Institute, Rež near Prague, CZECHOSLOVAKIA

To cite this Article Kahovec, Jaroslav , Ŝvec, František and Marhol, Milan(1978) 'SIMPLE PREPARATION OF AMINOMETHANEPHOSPHONIC ACID', Organic Preparations and Procedures International, 10: 6, 285 — 288
To link to this Article: DOI: 10.1080/00304947809355051
URL: http://dx.doi.org/10.1080/00304947809355051

ORGANIC PREPARATIONS AND PROCEDURES INT. 10(6), 285-288 (1978)

SIMPLE PREPARATION OF AMINOMETHANEPHOSPHONIC ACID

Jaroslav Kahovec* and František Švec

Institute of Macromolecular Chemistry, Czechoslovak Academy of Sciences, 162 06 Prague 6, CZECHOSLOVAKIA

Milan Marhol

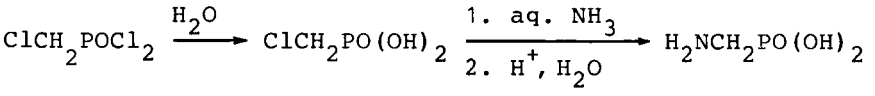
Nuclear Research Institute
250 68 Řež near Prague, CZECHOSLOVAKIA

Aminomethanephosphonic acid (I), a potential biologically active substance and complexing agent, may serve as a precursor or an intermediate for related substances with analogous functions.[1] Most of the useful methods for syntheses of higher α-aminoalkanephosphonic acids, however, cannot be used for its preparation.[1] The methods of synthesis of I are based mostly on the Arbuzov or Michaelis-Becker reaction of phosphites and alkylating derivatives of methylamines with protected amino group - and on subsequent deblocking and hydrolysis.[2-6] The amination of chloromethanephosphonic acid (II) and its derivatives is rather difficult due to the low reactivity of the chlorine atom. Thus, the amination of diethyl chloromethanephosphonate (III) with aqueous ammonia at 150° gave only 48-50% yield of crude amino ester.[7] All methods for the synthesis of I are rather time-consuming as they involve several synthetic steps as well as purification of the product and intermediates.

An attempted indirect amination of III with potassium phthalimide in anhydrous dimethylformamide (90-100°, 9 hrs or reflux 10 hrs),[8] gave only N-ethylphthalimide (90-95% yield; structure proved by the melting point and NMR spectrum, ethylamine hydrochloride was isolated after hydrazinolysis and acid hydrolysis) which was obviously formed as shown below.

III

Compound I was obtained by direct amination of II with aqueous ammonia[9] at 140-150° and isolation and purification of the product by chromatography on a strongly acid cation exchanger.



IV II I

EXPERIMENTAL

Aminomethanephosphonic acid (I). - Technical grade chloromethanephosphonic dichloride (IV, 135 g, 0.80 mol; Aldrich-Europe) was added dropwise to water (400 ml) with cooling and the solution obtained was heated to 100° for 3 hrs. The reaction mixture was evaporated to dryness in vacuo; the residue was dissolved in water and the solution was treated with charcoal, if needed. This procedure was repeated several times. The crude crystalline chloromethanephosphonic acid (II) thus obtained was dissolved with cooling in 25% aqueous ammonia (900 ml, 12 mol) and the solution was heated in a stainless-steel autoclave at 140-150° for 25 hrs. The reaction mixture

was evaporated to dryness in vacuo, dissolved in water and again evaporated to dryness. The residue was redissolved in water (ca. 400 ml), the solution was transferred on column containing 2200 ml of the cation exchanger Ostion KS (sulphonated copolymer styrene - 8% divinylbenzene, wet capacity 1.8 mval/ml, particle size 0.3-1.2 mm; United Chemical and Metallurgical Works, Ústí n.L.) in H^+ form and the column was eluted with water. The first strongly acid fractions of eluate are mixtures of various phosphonic acids and do not react with ninhydrin. Further fractions are only slightly acid, give positive ninhydrin reaction and, after evaporation yielded 30 g (34%) of I of high purity, mp. 325-330° (without decomposition); ref. [10,4,7,3] gives mp. 286.5°, 296-300°, 310°, 318-320° with decomp.

Anal. Calcd. for CH_6NO_3P: N,12.62; P,27.89. Found: N,12.70; P,27.49. NE(phenolphthalein): Calcd. 111.0. Found 109.3.

NMR (D_2O, 99°): δ 3.10 (d, J_{HP} = 13.1 Hz); ref.[3] gives δ 3.12 (d, J = 14.4 Hz).

REFERENCES

1. K. Prajer and J. Rachon, Z. Chem., 15, 209 (1975).
2. M. E. Chalmers and G. M. Kosolapoff, J. Am. Chem. Soc., 75 5278 (1953).
3. S. G. Warren, J. Chem. Soc. [C], 1349 (1966).
4. B. E. Ivanov, S. S. Krokhina, and A. V. Chernova, Izv. Akad. Nauk SSSR, Ser. Khim. Nauk, 606 (1968).
5. R. W. Ratcliffe and B. G. Christensen, Tetrahedron Lett., 4645 (1973).

6. K. Yamauchi, Y. Mitsuda, and M. Kinoshita, Bull. Chem. Soc. Japan, 48, 3285 (1975).

7. M. I. Kabachnik, T. Ya. Medved, "Syntheses of Organic Compounds" (in Russian), Vol. 2, p. 12 (1952), Chem. Abstr. 48, 564 (1954).

8. J. C. Sheehan and W. A. Bolhofer, J. Am. Chem. Soc., 72, 2786 (1950).

9. R. Coelln and K. Luerssen, German Patent (DOS) 2315886 (1974), Bayer A.-G., Chem. Abstr., 82, 4415 (1975).

10. J. R. Chambers and A. F. Isbell, J. Org. Chem., 29, 832 (1964).

(Received May 13, 1978; in revised form October 30, 1978)