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LETTERS TO THE EDITOR

Reaction of 3-(Ethylamino)-2,2-dimethylpropanal with Alkylene Phosphites

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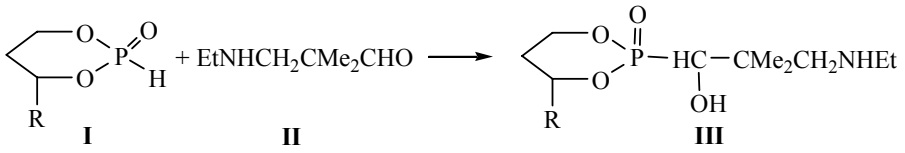
It is known that dialkylphosphites react with 3-(monoalkylamino)-substituted aldehydes to form 3-(alkylamino)-1-hydroxyphosphonates [1]. Alkylene phosphites were not previously entered into this reaction.

The aim of this work was to determine the structure of products of the reaction of alkylene phosphite **I** with 3-(ethylamino)-2,2-dimethylpropanal **II** and their subsequent acylation to obtain new polyfunctional organophosphorus compounds.

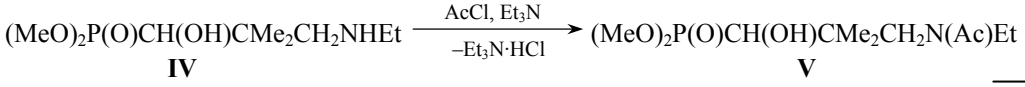
We first found that the reaction between compounds **I** and **II** proceeds under mild conditions in the absence of additional catalyst because the alkylamine group of the starting aldehyde **II** played the role of a basic catalyst. When adding dropwise the compound **II** to alkylene phosphites **I,** the reaction mixture temperature rose to 30–35ºC. The reaction mixture was stirred at 25ºC for 24 h (till the disappearance of the signal of the aldehyde proton at δ 9 ppm in the ^{1}H NMR spectrum).

O,*O*-Alkylene-1,3-[1-hydroxy-3-(ethylamino)-2,2-dimethylpropyl]phosphonates **III** are heat-sensitive, so they are identified in the crude form after removal of volatile substances in a high vacuum.



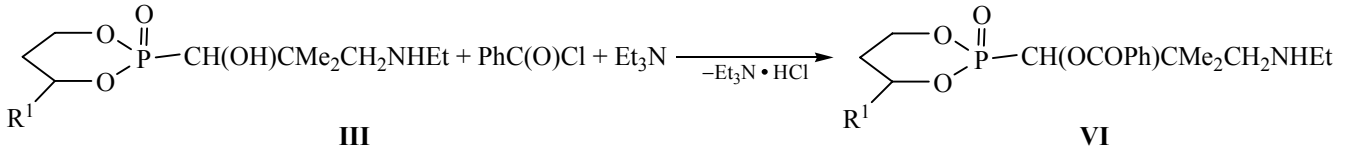
III, R = H (**a**), Me (**b**).

The structure of compounds **III**, besides the ^{1}H and ^{31}P NMR spectral data, was confirmed by acylation with benzoyl chloride. Compounds **III** have two reaction centers capable of acylating: hydroxy and secondary amine groups. Previously, we have found that acyclic phosphorus analog **IV** of compound **III** is exclusively acylated at the nitrogen to yield product **V**, in whose spectrum the CH-proton resonates at δ 3.76 ppm [1].



We found that the acylation occurred at the hydroxy group at the ratio of amino phosphonate **III** and benzoyl chloride 1:1.

The ^{1}H NMR spectrum of compound **VI** contains the methine proton signal at δ 5.92–5.94 ppm, close to the value of the proton chemical shift in the spectrum of acetoxy derivatives: 5.21–5.40 ppm [2]. In addition, in the ^{1}H NMR spectrum of compound **VI** there is a multiplet signal of NH-proton at δ 2.27 ppm. This fundamental difference in the direction of acylation of amino phosphonates with acyclic and cyclic phos-



III **VI**

VI, R = H (**a**), Me (**b**).

phorus moieties is probably due to the stronger screening of hydroxy group with the *O*,*O*-dialkylphosphoryl group rather than with *O*,*O*-alkylene phosphoryl group.

Thus, we first studied the reaction of alkylene phosphites **I** with 3-(ethylamino)-2,2-dimethylpropanal **II**, which results in a previously unknown compounds **III**. The reaction takes place under the mild conditions without a catalyst, since the alkylamine group of the starting aldehyde acts as the main catalyst. The reaction products **III** are acylated with benzoyl chloride at the hydroxy group.

***O*,*O*-Propylene-1,3-[1-hydroxy-3-(ethylamino)-2,2-dimethylpropyl]phosphonate (IIIa).** At room temperature were mixed 2.69 g (0.022 mol) of propylene-1,3-phosphorous acid **Ia** and 2.84 g (0.022 mol) of 3-(ethylamino)-2,2-dimethylpropanal **II**. An increase in the reaction mixture temperature to 35ºC was observed. The mixture thickened immediately. After removal of volatile substances the mixture was distilled in a vacuum to yield the heat-sensitive product **IIIa**. Yield 5.0 g (90%). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm: 1.11 t (3H, $NCH_2\underline{Me}$, $^3J_{HH}$ 7.0 Hz), 1.14 s (6H, CMe_2), 1.65–2.40 m (2H, $POCH_2\underline{CH_2}$), 2.59 q and 2.93 q [2H, CH_1H_2N, $^2J(H^1H^2)$ 12.4, $^4J(PH^1)$ 4.0, $^4J(PH^2)$ 3.0 Hz], 2.65 q (2H, $N\underline{CH_2}Me$, $^3J_{HH}$ 7.0 Hz), 3.79 d (1H, PCH, $^2J_{PH}$ 7.0 Hz), 4.15–4.88 m (4H, $POCH_2$), 5.12 br.s (2H, NH, OH). ^{31}P NMR ($CHCl_3$): δ_P 16.29 ppm. Found, %: N 5.50; P 12.45; $C_{10}H_{24}NO_4P$. Calculated, %: N 5.58; P 12.35.

***O*,*O*-Butylene-1,3-[1-hydroxy-3-(ethylamino)-2,2-dimethylpropyl]phosphonate (IIIb)** was obtained similarly from 8.16 g (0.06 mol) of compound **II** and 8.60 g (0.06 mol) of butylene-1,3-phosphorous acid **Ib**. Yield of the crude product 16.2 g (97%). ^{31}P NMR spectrum ($CHCl_3$): δ_P 15.18 ppm. Found, %: N 5.25; P 11.68. $C_{11}H_{24}NO_4P$. Calculated, %: N 5.28; P 11.70.

***O*,*O*-Propylene-1,3-[1-(benzoyloxy)-2,2-dimethyl-3-(ethylamino)propyl]phosphonate (VIa)** was obtained from 1.0 g (0.004 mol) of phosphonate **IIIa** in 50 ml of benzene, 0.56 g (0.004 mol) of benzoyl chloride, and 0.4 g (0.004 mol) of triethylamine. Yield 1.44 g (58%), mp 144ºC (benzene). ^{1}H NMR spectrum ($CDCl_3$), δ, ppm: 0.94 t (3H, $^3J_{HH}$ 7.0 Hz), 1.12 s and 1.27 s (6H, CMe_2), 1.72 q and 2.44 q [2H, $\underline{CH^1H^2}CH_2OP$, $^4J(PH^1)$ 4.5, $^4J(PH^2)$ 2.2, $^2J(H^1H^2)$ 14.2 Hz], 2.27 m (1H, NH), 3.73 d and 4.15 q [2H, CH^1H^2N, $^3J(H^1H^2)$ 14.2, $^3J(H^2H)$ 15.1, $^4J(PH^2)$ 5.7, $^4J(PH^1)$ 0 Hz], 3.60 d.q and 3.15 d.q [2H, $N\underline{CH^1H^2}Me$, $^2J(H^1H^2)$ 14.5, $^3J(H^1H) = {}^3J(H^2H)$ = 7 Hz], 4.29 m and 4.79 m (4H, CH_2OP), 5.94 d and 5.92 d (1H, PCH, $^2J_{PH}$ 28 Hz), 7.26–7.40 m (5H, C_6H_5). ^{31}P NMR ($CHCl_3$): δ_P 16.4 ppm. Found, %: N 4.14; P 8.40. $C_{17}H_{30}NO_5P$. Calculated, %: N 3.89; P 8.70.

***O*,*O*-Butylene-1,3-[1-(benzoyloxy)-2,2-dimethyl-3-(ethylamino)propyl]phosphonate (VIb)** was obtained from 5.15 g (0.03 mol) of phosphonate **IIIb** in 100 ml of benzene, 4.22 g (0.003 mol) of benzoyl chloride, and 3.03 g (0.003 mol) of triethylamine. Yield 4.01 g (50%), mp 150ºC (benzene). ^{31}P NMR spectrum ($CHCl_3$): δ_P 19.97 ppm. Found, %: N 3.70; P 8.48. $C_{18}H_{32}NO_5P$. Calculated, %: N 3.79; P 8.40.

The ^{1}H NMR spectra were registered on a Tesla BS-567A spectrometer operating at 100 MHz, internal reference TMS. The ^{31}P NMR spectra were recorded on a RYa-2303 instrument (21 MHz) relative to 85% H_3PO_4.

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