

LETTERS
TO THE EDITOR

Synthesis, Acid–Base Properties, and Complexing Properties of *N,N*-Bis[butoxy(hydroxy)phosphinoylmethyl]glycine

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Abstract—*N,N*-Bis(dibutoxyphosphinoylmethyl)glycine was synthesized by the Kabachnik–Fields reaction in the three-component system glycine hydrochloride–formaldehyde–dibutyl hydrogen phosphite. Saponification of the product gave *N,N*-bis[butoxy(hydroxy)phosphinoylmethyl]glycine as the normal potassium salt. pH-Metric titration was used to determine the ionization constants of *N,N*-bis[butoxy(hydroxy)phosphinoylmethyl]glycine, as well as the stability constants of its Mn(II), Co(II), Ni(II), Cu(II), and Zn(II) complexes.

Keywords: organophosphorus complexing agents, stability constants of complexes

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Previously we synthesized an organophosphorus analog of the well-known complexing agent nitrilotriacetic acid [1], specifically, potassium salt of aminotris(*O*-butyl methylphosphonic acid), and studied its acid–base and complexing properties with respect to divalent ions of certain transition metals [2, 3]. It was found that this triphosphorylated amine much differs in complexing properties from nitrilotriacetic acid, forming less stable complexes.

Herein, we proposed a method of synthesis of compound **2**, a diphosphorylated analog of nitrilotriacetic acid, which, as judged from its structure, should rank between the triphosphorylated amine and nitrilotriacetic acid in complexing power.

Potassium salt of *N,N*-bis[butoxy(hydroxy)phosphinoylmethyl]glycine **2** was prepared by saponification of diphosphorylated amine **1**, which, in its turn, was obtained by the Kabachnik–Fields reaction in the

three-component system glycine hydrochloride–formaldehyde–dibutyl hydrogen phosphate (Scheme 1).

The ionization constants of *N,N*-bis[butoxy(hydroxy)phosphinoylmethyl]glycine (H_3L) in aqueous solution were determined by pH-metric titration: $pK_1 < 1$, $pK_2 1.39 \pm 0.06$, $pK_3 2.15 \pm 0.04$, $pK_4 7.30 \pm 0.04$.

It was found that salt **2** forms water-soluble complexes with Mn(II), Co(II), Ni(II), Cu(II), and Zn(II) ions. The stability constants ($\log \beta$) of 1 : 1 ML[−], specifically, 6.24, 7.58, 8.21, 9.77, and 8.19 for the Mn(II), Co(II), Ni(II), Cu(II), and Zn(II) complexes, respectively, were determined by potentiometric titration. The resulting stability series agrees well with the Irving–Williams series [4]. The stability constants for compound **2** are higher than the respective values for the triphosphorylated analog by 2.5–3 $\log \beta$ units [2] but are lower of the stability constants of the complexes of nitrilotriacetic acid with the same series

