Complex Formation Between Glycine and Magnesium(II), Calcium(II), and Iron(II) at 25 °C in 3.00 M NaClO₄

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Equilibria occurring between glycine (L) and magnesium(II) and calcium(II) were studied by measuring at 25 °C the electromotive force (e.m.f.) of the cell:

\[
(\text{--) Pt, H}_2/\text{Solution S/R.E. (+)}
\]

where R.E. is the reference electrode described in the text.

Equilibria taking place in solutions containing iron(II) and glycine were investigated by means of the cell:

\[
(\text{--) R.E./Solution S/G.E. (+)}
\]

where G.E. is the glass electrode. The general composition of solution S was in both cases the following:

- \( B \) M in \( M^{2+} \);
- \( H \) M in \( H^+ \);
- \( A \) M in L;
- 3.00 M in ClO₄⁻;
- (3—H—2 B) M in Na⁺.

Experimental data were explained by assuming the existence of the species:

- \( \text{MgL} \ (\log \beta_{1,0,1} = 1.53 \pm 0.05) \);
- \( \text{MgL}_2 \ (\log \beta_{2,0,1} = 2.26 \pm 0.05) \);
- \( \text{CaL} \ (\log \beta_{1,0,1} = 0.75 \pm 0.03) \);
- \( \text{FeL} \ (\log \beta_{1,0,1} = 4.20 \pm 0.04) \).

Protonation constants of aminoacetate, not known in the experimental conditions selected, were determined by means of e.m.f. measurements carried out with a \( H_2 \) electrode.

(Keywords: Complexes; Glycine, metal complexes; Electrochemistry)
Alle Meßproben hatten die folgende allgemeine Zusammensetzung: \( B M \) in \( M^{2+} \); \( H M \) in \( H^+ \); \( A M \) in \( L \); 3,00 \( M \) in \( ClO_3^- \); (3—\( H—2 B \)) \( M \) in \( Na^+ \).

Die experimentellen Daten konnten unter Annahme folgender Komplexe erklärt werden: \( MgL (log \beta_{1,0.1} = 1.53 \pm 0.05) \); \( MgL_2 (log \beta_{2,0.1} = 2.26 \pm 0.05) \); \( CaL (log \beta_{1,0.1} = 0.75 \pm 0.03) \); \( FeL (log \beta_{1,0.1} = 4.20 \pm 0.04) \). Die Protonierungs- 

constants of Aminoacetat, die bei den gewählten experimentellen Bedingungen nicht bekannt sind, wurden mittels E.M.K. Messungen (mit Wasserstoff-Elektrode) bestimmt.

Introduction

This paper treats equilibria which take place in solutions where glycine and magnesium(II), or calcium(II), or iron(II) are present. Iron(II) was investigated in order to study in future the system iron(III)—glycine by means of e.m.f. measurements with a redox \( Fe^{3+}/Fe^{2+} \) electrode.

The three systems considered, were either not much studied or results of several investigations are often not complete or not in accord.

The system magnesium(II)—glycine has been studied by e.m.f. measurements carried out at 20 or 25 \( ^\circ C \) with a glass electrode and very low ionic strength \( \mu \rightarrow 0^1 \).

Two authors\(^2,3\) explain their experimental data by assuming the formation of \( MgL \) alone, but with different values of stability constants. Another author\(^4\) gives only approximate results; only one researcher\(^5\) finds two complexes \( MgL (log K = 3.45) \) and \( MgL_2 (log K = 3.01) \). The complex formation between calcium(II) and glycine was investigated by comparing the solubility of \( Ca(IO_3)_2 \) in the presence or in the absence of glycine\(^1\). The increase of solubility in the presence of glycine was explained by assuming the formation of \( CaL \) with values of stability constant varying from \( log \beta = 1.35 \) to \( log \beta = 1.43 \).

The system iron(II)—glycine was investigated in all cases by e.m.f. methods carried out by means of a glass electrode. Albert\(^6\) (at 20 \( ^\circ C \) and \( \mu = 0.01 \)) assumes the formation of \( FeL (log \beta_1 = 4.3) \) and \( FeL_2 (log \beta_2 = 7.8) \); Perrin\(^7\) finds (at 20 \( ^\circ C \) and in 1 \( M \) KCl) the formation of \( FeL (log \beta = 3.83) \) alone. More recently Izatt, Johnson, and Christensen\(^8\) find the complex \( FeL (log K = 4.31) \) at 25 \( ^\circ C \) and \( \mu \rightarrow 0 \).

The aim of this work is to study predominant equilibria in solutions containing glycine, magnesium(II), calcium(II) and iron(II), in a wide concentration range, in order to decide if one or two complexes are present and to compare the obtained results. Thus it is necessary to use a concentrated ionic medium and to use e.m.f. measurements carried out with the hydrogen electrode, if possible. It was selected 3.00 \( NaClO_4 \) as ionic medium. In parallel with this work, the same equilibria were investigated in self medium 3.00 \( M \) \( NaClO_4 \) and 3.00 \( M \) glycine\(^9\).