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Dissociation of ethylenediaminetetraacetic acid and stability of copper(II) ethylenediaminetetraacetates in aqueous solutions of ammonium nitrate

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Abstract

The dissociation constants (K1 and K2) of the carboxy groups of ethylenediaminetetraacetic acid (H4L) and the dissociation constant (K5) of the protonated form H5L+ were determined by pH-metric titration in the pH range 1.3-4.5 at variable concentrations of ammonium nitrate (μ = 1.0-7.0) in an aqueous solution (I = 25 ± 0.05°C). The dissociation constants of the ammonium groups in H4L (K3 and K4) failed to be determined under the experimental conditions chosen. For KNO3 and NaClO4 (μ = 1.2), all K1-K5 constants were calculated. The complexation of H4L with copper(II) in the presence of the supporting electrolytes of the indicated concentrations was studied by spectrophotometry and pH-metric titration. In the strongly acidic region, the [CuH3L]+ species was found to form, in addition to the diprotonated and monoprotonated copper(II) complexonates. The equilibrium constants for the formation of the complexonates change nonmonotonically with increase in the concentration of ammonium nitrate. At comparable ionic strengths of the solutions created by KNO3 (μ = 1.2), NH4NO3 (μ = 1.0), and NaClO4 (μ = 1.2), the effect of NaClO4 is most pronounced: the equilibrium constants decrease by ~2 units of logK for all the complexonates. The formation of the heteroligand complex [CuLNH3]2- in the aqueous solutions of ammonium nitrate (pH > 6) was established by the spectrophotometric method.