A polarographic study of methionine complexes of cadmium and indium

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ABSTRACT

The stability constants of methionine complexes of cadmium were determined polarographically by the method of DeFord and Hume as $\beta_1 = 6.5 \times 10^2$, $\beta_2 = 1.7 \times 10^6$ and $\beta_3 = 2.1 \times 10^8$. The indium complexes were studied by the modified method of Momoki and Ogawa and two complexes, with $\beta_4 = 1.7 \times 10^8$ and $\beta_5 = 8.4 \times 10^{13}$, were identified in the concentration range studied. The half-wave potential of uncomplexed indium ion which cannot be measured directly owing to the irreversible nature of the reduction was calculated as $-0.503$ V vs. SCE.

1. INTRODUCTION

Amino acid complexes of metals are of interest in biochemistry. Amino acids with a sulphur atom have a special significance in that they are indispensable for growth and their complexes with metals have been studied earlier.\textsuperscript{1-4} Methionine, having the formula $\text{CH}_3S(\text{CH}_2)_2\text{CH}(\text{NH}_2)\text{CO}_2\text{H}$, is the only hydrolysis product of proteins besides cystine and cysteine that contains sulphur and behaves as a bidentate ligand forming stable complexes with many metals. This paper reports the results of a polarographic study of cadmium and indium complexes with methionine.

2. EXPERIMENTAL

Measurements were made with a manual polarograph using a saturated calomel electrode (SCE) as the reference electrode and a dropping mercury electrode with $m^{2/3}n^{1/6}$ equal to $1.66 \text{ mg}^{2/3} \text{ sec.}^{-1/2}$. The tempe-
Polarographic study was maintained at $30 \pm 0.1^\circ C$ by means of a Townson and Mercer thermostat. The pH of the solutions was measured with a Beckman Expandomatic SS-2 pH meter. A stock solution of cadmium was prepared by dissolving cadmium sulphate (E. Merck, GR) in double distilled water and that of indium was obtained by dissolving indium metal (BDH AnalaR) in nitric acid and then fuming it with perchloric acid. These were estimated by standard methods. DL-methionine (E. Merck) was used without purification. The reported currents have been corrected for the residual current.

3. Results and Discussion

3.1. Cadmium System

Cadmium gave a well-defined reversible wave in 1 M potassium nitrate medium with the half-wave potential at $-0.579 \text{ V vs. SCE}$. The reduction remained reversible in the presence of methionine but the wave shifted to more negative potentials indicating complexation. The concentration of the methioninate ion was calculated from the pH of the solution and the pK of methionine, determined separately as 9.10 by the pH titration technique of Irving and Rossotti.5

A plot of the half-wave potential ($E_{1/2}$) vs. log (methioninate) resulted in a smooth curve (figure 1) indicating the presence of different species.