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NOTE

Electrochemical Study of Mixed-Ligand Complexes of In(III) with Succinic Acid and Serine

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The composition and stability constants of complexes formed by In(III) with succinic acid and serine have been investigated in aqueous media. The sample complex of In(III) with L-serine was first investigated and formation constants evaluated by DeFord and Hume's method and varified by Mihailov's method. The value of formation constants were found to be log β_{11} = 4.72, log β_{12} = 9.94, log β_{21} = 5.63 at 298 K, calculated by Schaap and McMaster method.

Key Words: In(III), DME, L-Serine, Succinic acid.

The investigations on mixed-ligand complexes have been stimulated due to their analytical applications. Their formation as intermediate in ligand displacement reaction as well as in metal ion and enzyme catalyzed reaction and their possible significance for biological process[1-9]. The mixed halide complex of Cd(II), Cu(II) and Pb(II) have been reported Zarigen[10], Fridman and Shrivastava *et al.*[11]. Singh *et al.*[12] studied the mixed-ligand complex of In(III) with pyridine carboxylate and thioglycolate-formate polarographically. Jain[13] studied the mixed-ligand complexes of In(III) with L-glutamate-L-methionate and L-glutamate-L-valinate/L-prolinate system polarographically. Schaap and McMaster method has been used by many others workers[14-21] to calculate the formation constants of mixed-ligand complexes. Gupta *et al.*[22] studied the complex of Cd(II) with itaconic acid and some amino acids. The present paper deals with the mixed-ligand complexes of In(III) with succinic acid and L-serine, and determine stability constants by Schaap and McMaster's method.

The experimental solution was prepared in measuring flasks of pyrex-glass using conductivity water. The solution contains 0.1 mM of In(III) with varying concentration of strong ligand (serine) and fixed concentration of weak ligand (succinic acid). Potassium chloride solution of concentration 1 M was used as supporting electrolyte to maintain the ionic strength of the solution at 0.1 M and 0.002 Triton X-100 was used as maxima supressor. The current-voltage measurements were performed with three electrode assembly, as dropping mercury electrode as working electrode and calomel as reference electrode and platinum as counter electrode. A CL 362 polarographic analyzer was used to record the current voltage data. The capillary with the following characteristics m = 4.62 mg/s, t = 2 s was used.

The weaker ligand in this system is succinic acid and two concentration of the weaker ligand were kept constant so as to get the values of mixed stability constants β_{11}, β_{12} and β_{21} by using the following relations.

$$\beta = \beta_{10} + \beta_{11}(Y) + \beta_{12}(Y)_2 \quad (1)$$

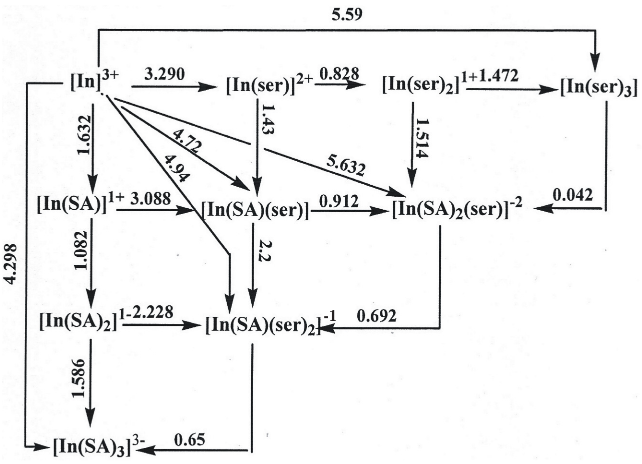
$$C = \beta_2 0 + \beta_{21}(Y) \quad (2)$$

Two equations with two unknown were simultaneously solved to give log β_{11} and log β_{12} for 1:1:1 and 1:1:2 mixed ligand complexes, respectively. The formation constant for the 1:2:1 mixed ligand complexes was computed from eqn. 2 and both the experimental values of 'C' gives the same values for β_{21}. These β_{11}, β_{12} and β_{21} values are recorded in Table-1.

TABLE-1
OVERALL FORMATION CONSTANTS OF MIXED-LIGAND In(III)-L-SERINE SUCCINIC ACID COMPLEXES AT 298 K

Mixed-ligand metal complexes	Formation constants
[In(Serine)(SA)]	log β_{11} = 4.72
$[In(Serine)(SA)_2]^{2-}$	log β_{12} = 4.94
$[In(Serine)_2(SA)]^{1-}$	log β_{21} = 5.632

The numerical values in each step are log K values where K is the equilibrium constant for each step indicated in the **Scheme-I**. The equilibria between various formed complex species in the ternary system have been shown in **Scheme-I**.



Scheme-I: In(III)-succinate-serinate complex

It can be seen from **Scheme-I** that $[In(SA)]^{1+}$ can add to serine more easily than $[In(Ser)]^{2+}$ to add (succinic acid) and also that tendency of $[In(SA)_2]^{1-}$ to add serine is more than to add succinic acid. In the same way $[In(Ser)_2]^{1+}$ has greater tendency to add succinic acid than to add serine. Like wise [In(Ser)(SA)] can add serine more easily than succinic acid as indicated by the values of equilibrium constant. From these results it can be concluded that In(III) forms stable mixed-ligand complexes as compared to single ligand in binary system.

The values of stability constant for mixed-ligand complexes are greater than the stability constants for the simple metal ligand system.

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