A Study of the Coordination Compounds of Some Transition Metals with 2-amino-2-methyl-1,3-propanediol

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Introduction

S.P. Datta and A.K. Grzybowski used a glass electrode to determine equilibrium constants for complexes of Ag^+ with 2-amino-2-methyl-1,3-propanediol (1). They found a value of 3.20 for log K_1 and a value of 3.66 for log K_2. We have used spectrophotometric data to determine the stepwise formation stability constants and the molar absorptivities for the complexes of Co^{2+}, Mn^{2+}, and Ni^{2+} with 2-amino-2-methyl-1,3-propanediol.

Experimental

A Cary Model 17 spectrophotometer was used to record precise absorbance measurements on solutions at 25 ° C. The 2-amino-2-methyl-1,3-propanediol was obtained from the Aldrich Chemical Company. The metal ion solutions were prepared from G. Frederick Smith Chemical Company $Co(ClO_4)_2 \cdot 6H_2O$, $Mn(ClO_4)_2 \cdot 6H_2O$, and $Ni(ClO_4)_2 \cdot 6H_2O$ reagents.

Spectrophotometric data were obtained from freshly prepared solutions. Separate aqueous stock solutions containing ligand and metal ion were prepared. Portions of the stock solutions were mixed with water for dilution to prepare a series of solutions 0.1-0.8 mM in Co^{2+} and 0.1-5.0 mM in ligand, a series 0.4-1.0 mM in Mn^{2+} and 0.4-3.2 mM in ligand, and a series 0.2-0.8 mM in Ni^{2+} and 0.2-6.0 mM in ligand. The solutions were mixed well, and absorption spectra were obtained as soon as possible after mixing. No inert electrolyte was added to raise the ionic strength. The solutions had low ionic strengths (0.3-3.0 mM). Approximately ninety solutions were prepared and many spectra were obtained.

Stability constants and the molar absorptivities at six wavelengths for Co^{2+}, six wavelengths for Mn^{2+}, and five wavelengths for Ni^{2+} complexes were calculated with the computer program of Lingane (2).

Results and Discussion

The values for the stability constants are given in Table 1 and those for the molar absorptivities in Tables 2-4. The equilibrium constants were highest for the Mn^{2+} com-

Table 1. Values of Stability Constants for Complexes of the Metal Ions with the Ligand

	Co^{2+}	Mn^{2+}	Ni^{2+}
log K_1	4.28	4.78	4.54
log K_2	2.87	3.78	2.71

Table 2. Values of Molar Absorptivities (ϵ,L mole^{-1} cm^{-1}) for Complexes of Co^{2+} with 2-amino-2-methyl-1,3-propanediol

λ,nm	210	220	230	240	250	260
ϵCoL^{2+}	525	423	321	243	163	88
ϵCoL_2^{2+}	2771	2260	2097	1852	1590	1361

TABLE 3. Values of Molar Absorptivities (ϵ, L mole^{-1} cm^{-1}) for Complexes of Mn^{2+} with 2-amino-2-methyl-1,3-propanediol

λ,nm	335	350	370	390	410	430
ϵMnL^{2+}	703	591	475	368	294	227
ϵMnL_2^{2+}	1545	1362	1156	994	863	761

TABLE 4. Values of Molar Absorptivities (ϵ,L mole^{-1} cm^{-1}) for Complexes of Ni^{2+} with 2-amino-2-methyl-1,3-propanediol

λ,nm	210	220	230	240	250
ϵNiL^{2+}	575	349	196	102	54
ϵNiL_2^{2+}	2509	1369	700	341	113

plexes. The first constant was higher for Ni^{2+} than for Co^{2+}. The second constant was higher for Co^{2+} than for Ni^{2+}. The values of log K_1 for Co^{2+}, Mn^{2+}, and Ni^{2+} were higher than the value of 3.20 found by Datta and Grzybowski (1) for Ag^+; while the values for log K_2 for Co^{2+} and Ni^{2+} were lower than the value of 3.66 found by them for Ag^+.

The molar absorptivities for the first complex were highest for Mn^{2+} and lowest for Ni^{2+}. The molar absorptivities for the second complex were highest for Co^{2+} and lowest for Ni^{2+}.

Literature Cited

1. Datta, S.P., and A.K. Grzybowski, 1959. The stability constants of the silver complexes of some aliphatic amines and amino-acids. Jour. Chem. Soc. (London). 1091-1095.
2. Lingane, P.J., and Z.Z. Hugus, Jr., 1970. Normal equations for the Gaussian least-squares refinement of formation constants with simultaneous adjustment of the spectra of the absorbing species. Inorganic Chem. 9:757-762.