RJC
http://www.rasayanjournal.com

RASĀYAN *J. Chem.*
Vol.2, No.2 (2009), 371-374
ISSN: 0974-1496
CODEN: RJCABP

COMPARATIVE POLAROGRAPHIC STUDIES OF Cd(II) COMPLEXES OF GLYCINE IN AQUEOUS AND AQUEOUS-NONAQUEOUS MEDIA

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ABSTRACT
The stability constants for the Cd(II)-glycine binary complex system have been determined using polarographic measurements in DMF-water mixture Ionic strength was maintained with KCl (μ=1.0M) and TritoX-100 was used as maxima suppressor. The study shows that the tendency of glycine to form complex with Cd(II) ions is greater in DMF-water mixture as compared to that in only water.
Keywords: Cd(II)-glycine binary complex; polarographic measurements.

INTRODUCTION

Mostly the inorganic polarographic investigation have been carried out in aqueous media and rare are the reports[1] citing advantages by carrying out such investigations in media other than aqueous. Mixed ligand complexes of transition metals with several amino acids have been studied by many workers[2-8]. Vast data are available on the stability constants of amino acids complexes in aqueous media[9-11]. Despite this, little is known about the chemistry of amino acids and metal complexes in nonaqueous media and mixed solvents[12-14]. The present communication deals with the studies of binary complexes of Cd(II) with glycine in DMF-water mixture.

EXPERIMENTAL

All reagents used were analytical grade and their solutions were prepared in conductivity water. The ionic strength was maintained constant at μ = 1.00 using KCl as supporting electrolyte. The concentration of Cd(II) was maintained at $5x10^{-4}$ M. Polarograms were obtained by means of a manual polarograph. All the measurements were obtained at 300K. A saturated calomel electrode was used as references electrode. The d.m.e. had the following characteristics m = 2.30 mg/sec., t = 3.20 sec. and h = 40 cm.

RESULTS AND DISCUSSION

All the plots of log (i/i_d-i) vs $E_{d.e.}$ yielded straight line with slopes (30±1mV) which established two electron reversible reduction. Linear plots of i_d vs $h^{1/2}$ passed through the origin, established the diffusion controlled nature, of the reduction at the electrode. When increasing amounts of glycine added to solutions containing $5x10^{-4}$ M Cd(II), requisite quantity of KCl and different percentages of DMF, a shift in the half-wave potential towards negative side and decrease in the diffusion current were observed. These indicate complex formation. The polarographic measurements and $F_j[X]$ functions, as determined by DeFord and Hume's method, have been recorded in Tables 1 to 3 for 10%, 20% and 30% DMF-water mixtures, respectively and shown graphically in Figures 1 to 3. The stability constants have been determined by DeFord and Hume's method which are redorded in Table 4. The values of stability constants for Cd(II)-glycine system in aqueous medium are summarized in Table 5. The results show that the stability constants are higher in DMF-water mixtures than in purely aqueous medium. This is expected because water has a high dielectric constant of about 80, so the electrostatic force of attraction between two ions of opposite charge in considerably reduced. Addition of organic solvent as DMF decreases the dieletric constant of the media, resulting in a greater attraction force and hence larger stability constants.

Table-1: Polarographic measurements and $F_j[X]$ values for the Cd(II)-glycinate system in 10% DMF. [Cd(II)] = 5x 10^{-4} M, $E_{1/2}$ of Cd(II) = - 0.6090 V vs SCE, i_d = 49 div., μ = 1.0 M KCl, temp. = 300K.

[gly] mol L^{-1}	Δ $E_{1/2}$	$\log I_m/I_c$	$F_0[X] \times 10^4$	$F_1[X] \times 10^6$	$F_2[X] \times 10^8$	$F_3[X] \times 10^{10}$
0.001	0.0885	0.1104	0.1220	1.2191	7.2902	9.8012
0.002	0.1037	0.1461	0.4289	2.1441	8.2703	9.8014
0.003	0.1140	0.1587	0.9796	3.2650	9.2550	9.8000
0.004	0.1214	0.1850	1.8394	4.5983	10.2706	9.9017
0.005	0.1275	0.1988	3.0474	6.0947	11.2094	9.7989
0.006	0.1322	0.2278	4.6846	7.8076	12.1961	9.8102
0.007	0.1366	0.2430	6.8002	9.7145	13.1779	9.8113
0.008	0.1403	0.2588	9.4484	11.8104	14.1505	9.8007

Table-2: Polarographic measurements and $F_j[X]$ values for the Cd(II)-glycinate system in 20% DMF. [Cd(II)] = 5x 10^{-4} M, $E_{1/2}$ of Cd(II) = - 0.6090 V vs SCE, i_d = 49 div., μ = 1.0 M KCl, temp. = 300K.

[gly] mol L^{-1}	Δ $E_{1/2}$	$\log I_m/I_c$	$F_0[X] \times 10^4$	$F_1[X] \times 10^6$	$F_2[X] \times 10^8$	$F_3[X] \times 10^{10}$
0.001	0.0933	0.1217	0.1812	1.8110	10.1600	12.1000
0.002	0.1083	0.1481	0.6139	3.0690	11.3700	12.1002
0.003	0.1183	0.1618	1.3713	4.5708	12.5860	12.1204
0.004	0.1253	0.1908	2.5243	6.3106	13.7890	12.0986
0.005	0.1313	0.2060	4.1616	8.3230	15.0560	12.2134
0.006	0.1357	0.2382	6.3148	10.5246	12.2160	12.1103
0.007	0.1399	0.2552	9.0928	12.9897	17.4210	12.1007
0.008	0.1436	0.2730	12.6111	15.7638	18.7110	12.2008

Table-3: Polarographic measurements and $F_j[X]$ values for the Cd(II)-glycinate system in 30% DMF. [Cd(II)] = 5x 10^{-4} M, $E_{1/2}$ of Cd(II) = - 1.6085V vs SCE, i_d = 41 div., μ = 1.0 M KCl, temp. = 300K.

[gly] mol L^{-1}	Δ $E_{1/2}$	$\log I_m/I_c$	$F_0[X] \times 10^4$	$F_1[X] \times 10^6$	$F_2[X] \times 10^8$	$F_3[X] \times 10^{10}$
0.001	0.1126	0.0943	0.7565	7.5649	26.6490	14.4998
0.002	0.1246	0.1357	2.1041	10.5200	28.1000	14.5000
0.003	0.1319	0.1814	4.1296	13.7653	29.5510	14.5016
0.004	0.1381	0.1978	6.9202	17.3004	31.0010	14.5020
0.005	0.1431	0.2148	10.5751	21.1500	32.5000	14.6004
0.006	0.1467	0.2510	15.1444	25.2406	33.9010	14.5012
0.007	0.1495	0.2906	20.7555	29.6506	35.3580	14.5123
0.008	0.1525	0.3117	27.5047	34.3808	36.8510	14.5632

Table-4: Successive stability constants for ML, ML_2 and ML_3 complexes of Cd(II) - glycinate in various percentages of DMF - water mixture.

Stability constants	10% DMF	20% DMF	30 DMF
log β_1	5.69	5.90	6.69
log β_2	3.80	8.90	9.40
log β_{13}	10.99	11.08	11.16

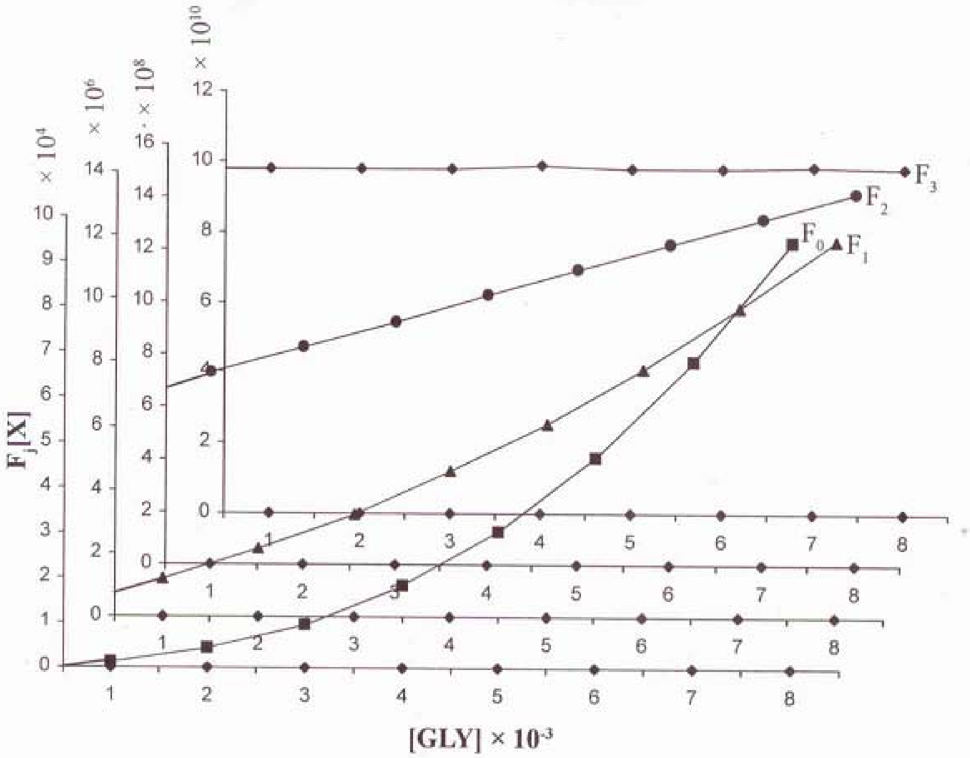

Fig. 1 : Plot of $F_j[X]$ vs [GLY] : Cd(II)-glycinate system in 10% DMF at 300K.

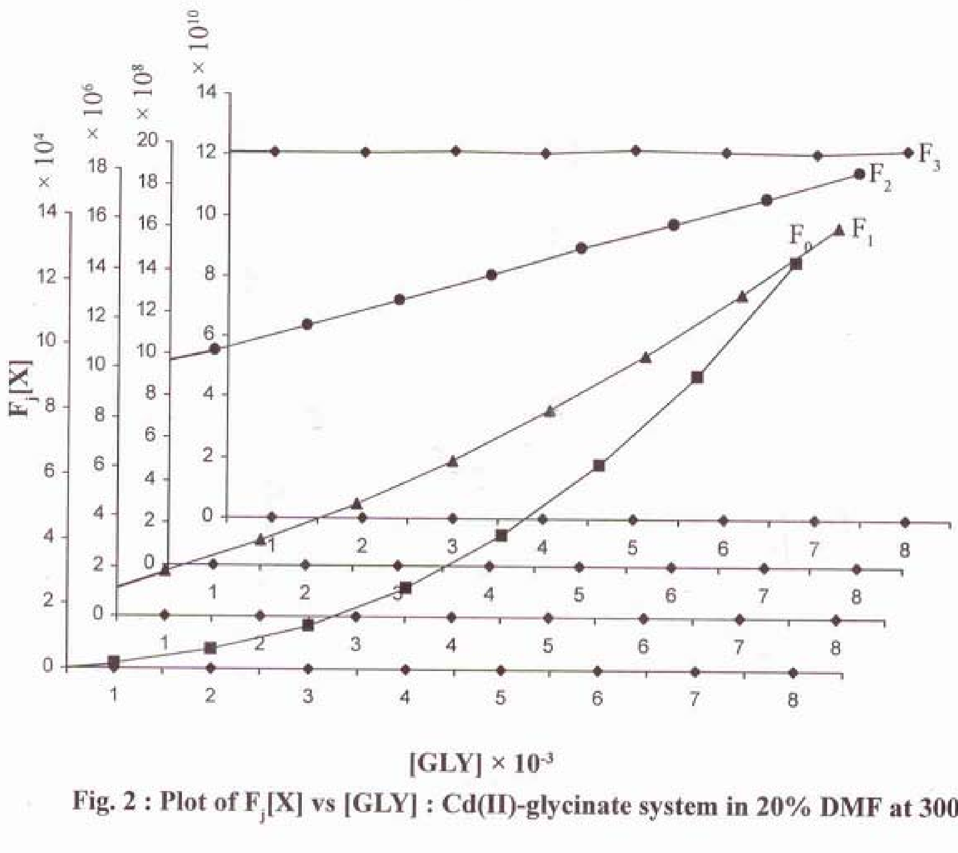

Fig. 2 : Plot of $F_j[X]$ vs [GLY] : Cd(II)-glycinate system in 20% DMF at 300K.

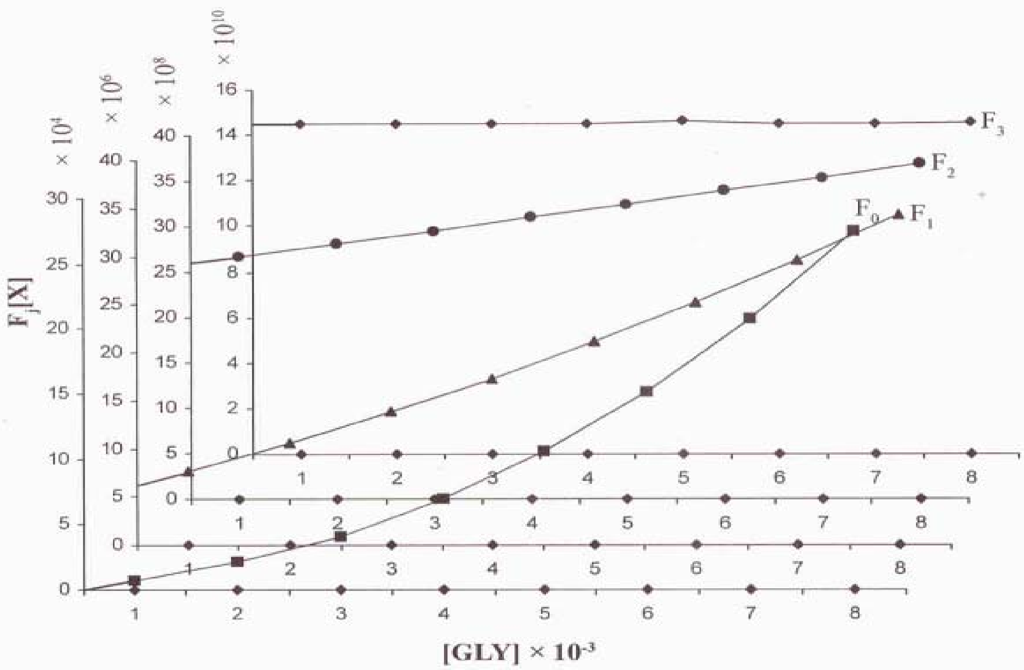

Fig. 3 : Plot of $F_j[X]$ vs [GLY] : Cd(II)-glycinate system in 30% DMF at 300K.

ACKNOWLEDGEMENTS

The authors are thankful to the Head, Department of Chemistry, University of Rajasthan, Jaipur for providing the facilities to carry out this research work. The authors Meena and Akhil K. Barjatya are thankful to CSIR and UGC respectively for the award of JRF.

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Table-5: Successive stability constants for ML, ML_2 and ML_3 complexes of Cd(II)-glycinate at 300K.

Temeprature	**Stability constant**		
	$[Cd(gly)]^{+1}$	**$[Cd(gly)_2]$**	**$[Cd(gly)_3]^{-1}$**
	log β_1	log β_2	log β_3
300K	4.30	7.70	9.85

(Received: 17 April 2009 Accepted: 5 May 2009 RJC-378)