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THE DETERMINATION OF THE STABILITY CONSTANTS OF MIXED LIGAND
COMPLEXES OF SUCCINIC ACID WITH Zn(II) BY POTENTIOMETRIC TITRATION
METHOD

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ABSTRACT

One of the most convenient and successful technique for metal-ligand complex is pH metry. Equilibrium study on complex formation of succinic acid with Zn(II) has been investigated pH-metrically in dioxan-water mixtures (0.0-50.0% v/v) at 328K and 0.1 mol dm⁻³ ionic strength. The primary ligand 3-ethyl-2,6-diphenylpiperidin-4-one thiocarbohydrazide [EDPT] was prepared by condensation of 3-ethyl-2,6-diphenylpiperidin-4-one and thiocarbohydrazide. The amino acid such as succinic acid were used as secondary ligand. The computer program is SCOGS method was obtained. The method of Calvin and Bjerrum as adopted by Irving and Rossotti has been employed to determine metal-ligand stability constant (logK) values. The ionic strength was maintained and complex formation was observed.

Key Words: pH metry, succinic acid, EDPT, formation, computer program.

1. INTRODUCTION

The important roles in coordination chemistry as they easily form stable complexes with most transition metal ions¹⁻². affecting the stability of the metal chelates along with their stability constants³⁻⁵. 1,4-dioxane-water medium at 27 ± 0.5oC have been reported by employing pH-metric titration technique⁶⁻¹¹. the stability constants of the mixed ligand complexes of Co(II), Ni(II), Cu(II) and Zn(II) with 2-[(E)-(2,6-dimethylphenyl)imino]methylphenol (X) as primary ligand and

The zinc(II) metal ion is second most abundant transition element in biological systems after iron to be found in the body and it plays significant roles in nature, industry and medicine due to its vast assortment of functions¹²⁻¹⁵. A survey of literature reveals that a number of thiocarbohydrazide and their derivatives have been used extensively to synthesise various derivatives of different heterocyclic compounds¹⁶⁻²⁰. 3-Mercapto-1,5-diphenylformazan (dithizone.dzH) was first prepared by Emil Fischer and Bestorn²¹ over a century ago. In 1925 Hellmut Fischer²² introduced dithizone as a versatile analytical reagent and subsequently exploited its use for the solvent extraction and quantitative estimation of a number of

metal industrial and toxicological interest. The conditions for the isolation and determination of a wide variety of metals as their dithizonate or substituted dithizonate have been well reviewed²³⁻²⁴. The ligand forms neutral complexes with soft metal ions with several 'border line' metals.

Symmetric and asymmetric derivatives of carbohydrazide and thiocarbohydrazide have been studied due to their possibilities as analytical reagents. Thiocarbohydrazide are compounds with known carcinostatic and the antiviral activity of such ligands and

their complexes were linked to these properties, which allow various practical applications²⁵⁻³².

Thiocarbohydrazide and its hydrazones act as a neutral bidentate ligand due to the presence of the azomethine (-C=N-), hydrazine (-NH-NH₂) and thione (>C=S) groups in the molecule. Protonation equilibrium constants of thiocarbohydrazide have been reported by Brainbantiet *al.*³³. The association constants of this ligand with divalent metals in acidic solutions have been determined. Burns³⁴ has studied complexes of this ligand with Co(II), Ni(II), Zn(II), Cd(II) and Hg(II) in the solid state. Burns³⁴ concluded, on the basis of their infrared spectra, that they contain a ring of the thio-ketonic form. Campiet *al.*³⁵ have studied the association equilibria of the analogous ligand carbohydrazide, O=C(NHNH₂)₂, with divalent metals. They suggested that this ligand chelates through N, N forming a six membered ring. The discovery that the molecule of thiocarbohydrazide is itself in *trans* configuration further supports this hypothesis. The formation of analogous ring in complexes of thiocarbohydrazide (S, N donor) and in complexes of carbohydrazide (O,N donor) is confirmed by the small but sufficient, difference between the stability constants for the two ligands.

Infact, for nickel, K1 (caz)>K1 (tcaz) where as for the other metals the reverse is true. This is in accordance with the conclusions of Arhlandet *al.*³⁶, Arhland³⁷ and Suzuiki and Yamasaki²⁷ who affirm that affinity of zinc uncharged is less sulfur than for oxygen while affinity of nickel is more for sulfur than for oxygen. The study of the protonation equilibria³³ of thiocarbohydrazide has shown that in acidic media the thiocarbohydrazide can associate with two protons, one for the each hydrazide group, thus maintaining the thioketonic form. On the other hand in alkaline media the molecule probably changes into a thioenolic form because it is deprotonated twice.

Braibant *et al.*³³ have determined the association equilibria of this ligand with divalent metals in acidic media. In alkaline media precipitation of solid substances makes it possible to study the equilibria by potentiometric or spectrophotometric methods.

Titration with Cu(II) and Cd(II) failed because of precipitation of solid compounds even in acidic media; Mn does not show detectable association. The equilibrium constants of thiocarbohydrazide (tcz) with divalent metals are closely related to the equilibrium constant presented by carbohydrazide (caz)³⁵. The equilibrium constants of these ligands they probably belong to a common family. For these ligands five membered ring chelates can be postulated.

2. MATERIAL AND METHODS

Preparation of 3-ethyl-2,6-diphenyl piperidin-4-thiocarbohydrazone

An equimolar (0.05 mol dm⁻³) mixture of 3-ethyl-2,6-diphenylpiperidine-4-one²⁸ and thiocarbohydrazide²³ was treated with 1g of anhydrous sodium acetate in 150 ml of rectified spirit. This mixture was refluxed for 12 to 16 hrs. The insoluble product was filtered off and the volume of the filtrate was reduced by heating over a steam bath and poured into de-ionized water. The pale yellow colored product formed was filtered in a bucket funnel, dried and was recrystallized from benzene-petroleum ether (40-60°C) fraction. Yield was 40% (m.p.79°C). The purity of the product was checked by TLC method.

Characterization of ligands

Microanalyser and IR techniques characterized the ligand EDPT. IR spectra were recorded on a JASCO 700 spectrophotometer in KBr pellets. Microanalysis of the ligand EDPT was determined by standard method nitrogen²⁹ and sulphur²⁹; Zn:19.40 (19.83), S: 9.00 (9.06), for EDPT.

Metal ion solutions

Approximately 0.01 mol dm⁻³ stock solution of zinc ion, zinc(II) per chloride and the metal solutions were standardized using reported procedures²⁹.

Calibration of pH meter in dioxan-water medium

A mixture of 50% (v/v) dioxan-water medium was used since the chelates formed are relatively insoluble in water. Therefore, it was necessary to calibrate the pH meter in dioxan-water medium. To accomplish this the following concentrations of perchloric acid in 50% (v/v) dioxan-water medium were prepared (total volume 50 ml) and the pH meter readings (B values) were measured in all cases (Table 1).

Table 1 Calculated and observed values of pH

Conc. of [H ⁺]	Calculated pH	Observed pH
3.4713×10^{-4}	3.45	3.51
6.9482×10^{-4}	3.16	3.21
1.0422×10^{-3}	2.98	3.02
1.3896×10^{-3}	2.85	2.90
1.7370×10^{-3}	2.76	2.80

$$\text{Intercept} = -0.028$$

$$r = 0.9998$$

The following mixture a, b, c, d were prepared from each system and titrate against standard alkali solution using Bjerrum-Calvin pH titration technique.

- 3 ml of perchloric acid (0.10422 mol dm⁻³) + 3 ml of sodium perchlorate (1 mol dm⁻³) + 15 ml dioxan + 9 ml of water.
- 3 ml of perchloric acid (0.10422 mol dm⁻³) + 3 ml of sodium perchlorate (1 mol dm⁻³) + 5 ml of primary ligands/secondary ligand (0.01 mol dm⁻³) + appropriate amount of dioxan and water.
- 3 ml of perchloric acid (0.10422 mol dm⁻³) + 3 ml of sodium perchlorate (1 mol dm⁻³) + 2 ml of primary ligand/3ml of secondary ligand (0.01 mol dm⁻³) + 3 ml of zinc ion (0.01 mol dm⁻³) + appropriate amount of 1,4-dioxan + appropriate amount of water.
- 3 ml of perchloric acid (0.1 mol dm⁻³) + 3 ml of sodium perchlorate (1 mol dm⁻³) + 2 ml of primary ligand (0.01622 mol dm⁻³) and 3ml of secondary ligand (1:1) + appropriate amount of 1,4-dioxan and appropriate amount of water + 3 ml of zinc ion (0.01 mol dm⁻³).

3. RESULT AND DISCUSSION

IR spectral studies

A comparison of IR spectra of the ligands with starting compounds is also done to confirm the condensation between the starting compounds. The ligands spectra show a broad band around 3410-3390 cm⁻¹²³ which is attributed to the presence of secondary amine of piperidine ring nitrogen and thiocarbohydrazideazine group (-NH - NH₂). The band due to NH₂ wagging vibrations appear in the region 750-756 cm⁻¹³⁰. The disappearance of the bands pertains to the ketocarbonyl at 1705-1700 cm⁻¹ of 3-ethyl-2,6-diphenylpiperidin-4-one, and new band appeared at 1625 cm⁻¹ of EDPT is attributed to the formation of azomethine (C=N) group. The absence of any band in the region 2500-2600 cm⁻¹ confirms the presence of thioamide (N-C-N) group in the thione form exclusively^{23,29}. The other stretching vibrational frequencies are unaltered.

Ternary Zinc(II) – succinic acid complexes

The association constant of EDPT, Succinic acid, and stability constant of binary and ternary Zn determined in 50% (v/v) 1-4-dioxane water mixture at 35°C and data are given in Tables (2-5) and Fig. (1).

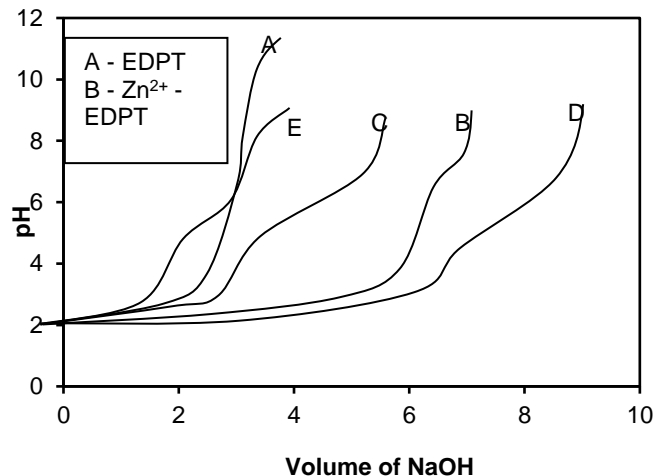
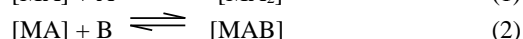
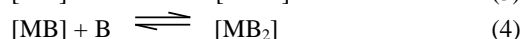


Fig. 1. pH metric titration curve for Zn²⁺-EDPT-succinic acid system

When a metal ion is equilibrium with two different ligands, A and B both of which can form *bis* complexes with the metal, equilibria (1)-(4) forming simple non-protonated *bis* complexes will be present the following





Sigel³⁰, two equilibrium constants involved in ternary complexes can be defined, logK which

$$\beta \log K = \log K_{MAB}^{MA} - \log K_{MB}^M$$

$$= \log K_{MAB}^M - \log K_{MA}^M \quad (5)$$

Table 2 pH titration data of EDPT at 35 ± 0.1°C in dioxan-water (50 % v/v)

Ionic strength [I] = 0.1 mol dm⁻³[EDPT] = 0.00517 mol dm⁻³

[HClO₄] = 0.010442 mol dm⁻³Initial volume = 30 ml

[NaOH] = 0.1271 mol dm⁻³V = volume of 0.1271 mol dm⁻³NaOH.

Volume of NaOH ml	pH	Volume of NaOH ml	pH
0.00	2.20	3.10	5.87
0.50	2.30	3.12	6.01
1.00	2.42	3.14	6.11
1.50	2.56	3.16	6.35
1.75	2.67	3.18	6.51
2.00	2.79	3.20	6.91
2.05	2.82	3.22	7.27
2.13	2.88	3.24	7.71
2.15	2.90	3.23	8.11
2.20	2.93	3.28	8.55
2.25	2.97	3.30	8.83
2.30	2.99	3.32	9.29
2.35	3.04	3.34	9.58
2.40	3.15	3.36	9.82
2.45	3.25	3.38	9.99
2.52	3.35	3.40	10.03
2.55	3.37	3.42	10.12
2.60	3.46	3.44	10.35
2.65	3.55	3.46	10.40
2.70	3.85	3.48	10.50
2.75	4.00	3.50	10.59
2.80	4.30	3.52	10.66
2.85	4.90	3.56	10.84
2.90	5.01	3.61	10.99
2.95	5.17	3.64	11.03
2.95	5.17	3.68	11.10
3.00	5.33	3.72	11.16
3.02	5.50	3.76	11.25
3.04	5.60	3.80	11.32
3.06	5.70	3.84	11.36
3.08	5.80	3.88	11.38

Table 3 pH titration data of Zn²⁺-EDPT at 35 ± 0.1°C in dioxan-water (50 % v/v)

Ionic strength [I] = 0.1 mol dm⁻³[HClO₄] = 0.010442 mol dm⁻³

[Zn²⁺] = 0.0015 mol dm⁻³[EDPT] = 0.00517 mol dm⁻³

V = volume of 0.1271 mol dm⁻³NaOH.Initial volume = 30 ml

Volume of NaOH ml	pH	Volume of NaOH ml	pH	Volume of NaOH ml	pH
0.00	2.27	4.75	3.00	6.24	6.45
0.20	2.30	4.80	3.02	6.26	6.56
0.40	2.33	4.85	3.04	6.28	6.65
0.60	2.34	4.90	3.06	6.30	6.75
0.80	2.35	4.95	3.10	6.32	6.79
1.00	2.37	5.00	3.13	6.34	6.85

1.20	2.38	5.05	3.15	6.36	6.93
1.40	2.40	5.10	3.16	6.38	6.97
1.60	2.42	5.15	3.19	6.40	7.01
1.80	2.43	5.20	3.22	6.42	7.04
2.00	2.45	5.25	3.25	6.44	7.08
2.20	2.46	5.30	3.29	6.46	7.12
2.40	2.48	5.35	3.33	6.48	7.15
2.60	2.50	5.40	3.38	6.50	7.19
2.80	2.52	5.45	3.40	6.52	7.22
3.00	2.56	5.50	3.46	6.54	7.26
3.20	2.58	5.55	3.52	6.56	7.29
3.40	2.62	5.60	3.58	6.58	7.33
3.60	2.70	5.65	3.65	6.60	7.36
3.80	2.74	5.70	3.77	6.62	7.39
4.00	2.76	5.75	3.91	6.64	7.41
4.05	2.77	5.80	4.05	6.66	7.45
4.10	2.79	5.85	4.24	6.68	7.49
4.15	2.80	5.90	4.45	6.70	7.54
4.20	2.81	5.95	4.78	6.72	7.56
4.25	2.82	6.00	5.02	6.74	7.61
4.30	2.83	6.02	5.14	6.76	7.66
4.35	2.84	6.04	5.26	6.78	7.73
4.40	2.86	6.08	5.40	6.80	7.80
4.40	2.87	6.10	5.53	6.82	7.93
4.45	2.89	6.12	5.65	6.84	8.06
4.50	2.91	6.14	5.77	6.86	8.48
4.55	2.93	6.16	5.89	6.88	8.89
4.60	2.94	6.18	6.01	6.90	9.21
4.65	2.96	6.20	6.17		
4.70	2.98	6.22	6.33		

Table 4 pH titration data of Succinic acid at 35 ± 0.1°C in dioxan-water (50 % v/v)

Ionic strength [I] = 0.1 mol dm⁻³

[HClO₄] = 0.010442 mol dm⁻³

Succinic acid = 0.003966 mol dm⁻³

Initial

volume = 30 ml

V = volume of 0.1271 mol dm⁻³NaOH.

Volume of NaOH ml	pH	Volume of NaOH ml	pH	Volume of NaOH ml	pH
0.00	2.16	3.45	4.81	4.70	6.45
0.20	2.18	3.50	4.93	4.75	6.51
0.40	2.23	3.55	5.04	4.80	6.57
0.80	2.26	3.60	5.11	4.85	6.62
1.00	2.30	3.65	5.18	4.90	6.68
1.20	2.34	3.70	5.25	4.95	6.74
1.40	2.38	3.75	5.33	5.00	6.80
1.60	2.48	3.80	5.39	5.05	6.87
1.80	2.88	3.85	5.45	5.10	6.94
2.00	2.66	3.90	5.50	5.15	6.99
2.20	2.73	3.95	5.56	5.20	7.06
2.40	2.77	4.00	5.63	5.25	7.14
2.60	2.84	4.05	5.69	5.30	7.25
2.80	3.02	4.10	5.75	5.35	7.36
2.85	3.20	4.15	5.81	5.40	7.47

2.90	3.32	4.20	5.87	5.42	7.60
3.00	3.44	4.25	5.93	5.44	7.87
3.05	3.56	4.30	5.99	5.46	8.64
3.10	3.68	4.35	6.05	5.48	8.14
3.15	3.81	4.40	6.11	5.50	8.35
3.20	4.00	4.45	6.16	5.52	8.56
3.25	4.19	4.50	6.22	5.54	8.77
3.30	4.38	4.55	6.28	5.56	8.98
3.35	4.57	4.60	6.34		
3.40	4.69	4.65	6.39		

Table 5 pH titration data of Succinic acid with Zn²⁺ at 35 ± 0.1°C in dioxan-water (50 % v/v)

Ionic strength [I] = 0.1 mol dm⁻³[HClO₄] = 0.010442 mol dm⁻³
 Succinic acid = 0.003966 mol dm⁻³ Initial volume = 30 ml

[Zn²⁺] = 0.0015 mol dm⁻³ V = volume of 0.1271 mol dm⁻³NaOH.

Volume of NaOH ml	pH	Volume of NaOH ml	pH	Volume of NaOH ml	pH
0.00	2.11	5.60	2.93	7.50	5.65
0.20	2.12	5.80	3.05	7.55	5.73
0.40	2.13	6.00	3.16	7.60	5.81
0.60	2.14	6.10	3.23	7.65	5.89
0.80	2.15	6.20	3.30	7.70	5.97
1.00	2.16	6.30	3.38	7.75	6.06
1.20	2.17	6.40	3.58	7.80	6.15
1.40	2.18	6.45	3.78	7.85	6.23
1.60	2.20	6.50	3.92	7.90	6.31
1.80	2.21	6.55	4.20	7.95	6.39
2.00	2.23	6.60	4.34	8.00	6.47
2.20	2.25	6.65	4.44	8.05	6.55
2.40	2.26	6.70	4.54	8.10	6.58
2.60	2.28	6.75	4.64	8.15	6.67
2.80	2.30	6.80	4.74	8.20	6.79
3.00	2.32	6.85	4.81	8.25	6.88
3.20	2.34	6.90	4.88	8.30	6.97
3.40	2.36	6.95	4.95	8.35	7.11
3.60	2.39	7.00	5.03	8.40	7.24
3.80	2.42	7.05	5.12	8.45	7.46
4.00	2.46	7.10	5.17	8.50	7.68
4.20	2.50	7.15	5.22	8.55	7.90
4.40	2.55	7.20	5.26	8.60	8.14
4.60	2.60	7.25	5.32	8.62	8.29
4.80	2.64	7.30	5.38	8.64	8.54
5.00	2.71	7.35	5.44	8.66	8.79
5.20	2.75	7.40	5.51	8.68	9.04
5.40	2.84	7.45	5.58	8.70	9.41

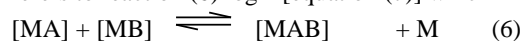
Table 6 pH titration data of Succinic acid and EDT with Zn²⁺ at 35 ± 0.1°C in dioxan-water (50 % v/v)

Ionic strength [I] = 0.1 mol dm⁻³[HClO₄] = 0.010442 mol dm⁻³
 Succinic acid = 0.003966 mol dm⁻³Initial volume = 30 ml

[Zn²⁺] = 0.0015 mol dm⁻³[EDPT] = 0.00517 mol dm⁻³
 V = volume of 0.1271 mol dm⁻³NaOH.

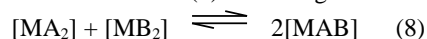
Volume of NaOH ml	pH	Volume of NaOH ml	pH	Volume of NaOH ml	pH
0.00	2.13	2.45	5.22	3.46	8.12
0.20	2.16	2.50	5.29	3.48	8.18
0.40	2.22	2.55	5.37	3.50	8.22
0.60	2.28	2.60	5.44	3.52	8.29
0.80	2.35	2.65	5.50	3.54	8.34
1.00	2.44	2.70	5.59	3.56	8.40
1.20	2.56	2.75	5.64	3.58	8.44
1.40	2.67	2.80	5.76	3.60	8.46
1.45	2.70	2.85	5.85	3.62	8.52
1.50	2.75	2.90	5.92	3.64	8.56
1.55	2.80	2.95	6.02	3.66	8.60
1.60	2.86	3.00	6.11	3.68	8.64
1.65	2.96	3.05	6.25	3.70	8.67
1.70	3.00	3.10	6.40	3.72	8.71
1.75	3.16	3.15	6.55	3.74	8.74
1.80	3.28	3.20	6.80	3.76	8.77
1.85	3.38	3.22	6.95	3.78	8.80
1.90	3.50	3.24	7.09	3.80	8.83
1.95	3.60	3.26	7.20	3.82	8.86
2.00	3.80	3.28	7.35	3.84	8.90
2.05	4.00	3.30	7.51	3.86	9.03
2.10	4.25	3.32	7.60	3.88	9.06
2.15	4.45	3.34	7.70	3.90	9.09
2.20	4.70	3.36	7.77	3.92	9.12
2.25	4.80	3.38	7.87	3.94	9.15
2.30	4.90	3.40	7.97	3.96	9.29
2.35	5.05	3.42	8.02		
2.40	5.14	3.44	8.08		

refers to reaction (6) logX [equation (7)] which



$$\log X = 2\log \beta_{MAB} - \log \beta_{MA_2} - \log \beta_{MB_2} \quad (7)$$

refers to reaction (8). Thus logK is a measure of the



The affinity that he has for bonding to the aquated metal ion and to the complex [MA]. Since more coordination side are available for bonding the first ligand to a metal ion than for the second ligand, the ΔlogK should, in general, negative with Zn²⁺ usually having a coordination number of four, the expected value for ΔlogK – 0.6, value markedly greater than this demonstrating a stabilisation of the ternary complex. In fact, positive values mean that prefers to bond to the complex [MA] rather than to the solvated metal ion. log X is really a dispropagation constant. Statistically a value of log4 is to be expected, so that values for logX of greater than 0.6 suggest that stabilisation of the ternary complexes. The value of log X is clearly dependent on the stability of the binary bis complexes and since these bis complexes are not intermediate the formation of the ternary complexes³¹, the value of logX may not truly reflect the stability of the mixed complex. However, logX will tend to be less

dependent than logK on differences in the charges on ligands A and B. Hence the choice between using logK and logX to give a measure of the stabilisation of ternary complexes depend on the particular comparison being made.

The association constant of Succinic acid, assigned as ligands(B) and the stability constants of the parent binary complex of Zn(II) at 35°C in I = 0.1 mol dm⁻³ (NaClO₄) used for the computation of mixed ligand complex system is reported. The data of Zn-EDPT binary system estimated under identically experimental conditions are reported. Log values obtained for 1:1, 1:2 Zn(II)-EDPT complex compared favourably with values expected for nicotinic acid like mode of binding of EDPT (Table 6). The Zn-A/ succinic acid system showed the presence of one mixed complex of ZnAB.

It appears that complex formation between EDPT and Zn(II). In the ZnAB species involves the formation of chelate ring the comparison of log K_{ZnAB}^{ZnA} (Table 7) and log K_{ZnB}^{Zn} clearly indicate that all the ligands form five membered chelate ring in the ZnAB complex species.

Thus, ZnAB species would contain five membered chelate ring since more coordination positions are available for binding the first ligand to metal ion than for second ligand, negative values for ΔlogK_{ZnAB} are expected (eq. 9 and 10).

Table 7 Negative logarithms of the acidity constants of the ligand (EDPT) and logarithms of the stability constants of the binary Zn²⁺ complexes (I = 0.1 mol dm⁻³) at; 35°C

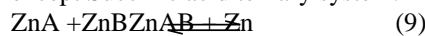
System	Protonation / stability constants
A/EDPT	pK ₁ = 12.50 pK ₂ = 16.62
Zn-A/ Zn-EDPT	logβ ₁ = 7.9 log β ₂ = 7.9

Table 8

Complex formation constants for the ternary complexes of EDPT-Zinc with some normally bidentate L-amino acids at 35°C (NaClO₄) standard deviation are given in parentheses

Parameters	L-Succi
logβ _{HB}	8.92
logβ _{H₂B}	10.86
log®β _{H₃B}	-
LogK _{ZnB}	11.21 (2)
LogK _{ZnB₂}	-
LogK _{ZnAB}	17.64 (4)
ΔlogK _{ZnAB}	- 1.72
ΔlogX _{ZnAB}	-

But the ΔlogK_{ZnAB} for the present investigation is positive except Succinic acid ternary system.



$$\Delta \log K_{ZnAB} = \log \beta_{ZnAB} - (\log \beta_{ZnA} + \log \gamma \beta_{ZnB}) \quad (10)$$

This indicates that succinic acid ligand prefers to add Zn-EDPT binary complex rather than to aquated Zn(II). Also, the positive

ΔlogK_{ZnAB} values suggest that formation of ternary complex, ZnAB is preferred over the binary complex of Zn_A or Zn_B.

However, the maximum amount of total Zn(II) present in the Zn_{AB} complex is only about maximum 40%, the lesser percentage of complex formation attributed to steric faster associated with five membered chelating ring in the species. Distribution of various species as a function of pH of various ternary system in Tables (8-11) and Figs. (2).

Distribution diagram obtained interms of percentage found Zn(II) as a function of pH in all four binary and ternary systems in the study, show the same quality features of formation of ternary complex species other binary complex species.

The existence of member of species in equilibrium of all pH values in ternary system where is certain pH regions. The concentration of one complex strongly predominant (Figs. 2).

Fig. 2. Charge distribution for Zn-EDPT-Succinic acid system between pH Vs Percentage of complex

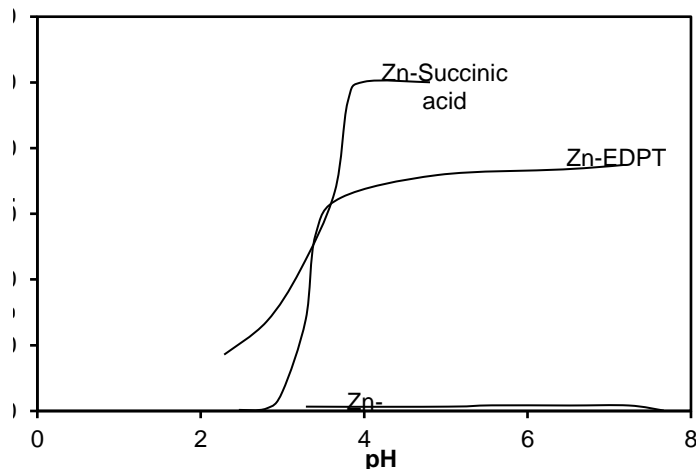


Table 9 Data for charge distribution of Zn-EDPT system pH versus percentage of complex

pH	Percentage of complex
2.27	0.0067
2.37	0.0260
2.45	0.0362
2.48	0.0742
2.56	0.2298
2.79	0.46
2.89	1.49
3.10	9.28
3.30	29.2
3.58	62.0
4.78	70.6
5.53	72.2
6.33	73.2
6.65	74.6
6.79	74.7
7.08	74.7

Table 10 Data for charge distribution of Zn-Succinic acid system pH versus percentage of complex

pH	Percentage of complex
2.30	10.7
2.42	11.5
2.54	13.8
2.68	14.0
2.80	21.0
2.94	29.0
3.13	41.2
3.31	55.0
3.46	79.4
3.56	100
3.67	100
3.82	100
4.17	100
4.25	100
4.33	100
4.44	100

Table 11 Data for charge distribution of Zn-EDPT – Succinic acid system pH versus percentage of complex

pH	Percentage of complex
2.28	10.3
2.36	15.4
2.45	22.2
2.57	25.6
2.68	27.6
2.80	28.2
2.90	29.6
3.10	25.4
3.24	23.2
3.44	22.6
3.56	21.4
3.68	20.2
3.85	19.5
4.10	17.51
4.22	13.62
4.32	8.46
4.50	6.42
4.80	4.16
4.98	2.61

4.CONCLUSION

In summary, The synthesis of mixed ligand complex of Zn(II) from Schiff base derived. These mixed ligand complex was prepared and characterized by microanalyser and IR techniques. The primary ligand 3-ethyl-2,6-diphenylpiperidin-4-one thiocarbohydrazone[EDPT] was prepared by condensation of 3-ethyl-2,6-diphenylpiperidin-4-one and thiocarbohydrazone in rectified spirit. The ligand was checked by TLC and melting point. The amino acids such as succinic acid were used as secondary ligand in potentiometric titration technique in aqueous 1,4-dioxan (0.1 mol dm⁻³). The protonation constants are determined by SCOGS method. Computer programme is obtained; data are very close to reported value. The overall stability constant reveals that ternary complex formation is more favoured than binary complexes. The stability constant of succinic is greater in this systems.

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