



## Stability Constant of Mixed Ligand Complexes of V(II) Metal with 8-Hydroxyquinoline and L-Amino Acids in 70% Methanol-Water Mixture

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### ABSTRACT

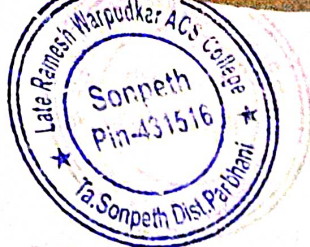
The stability constant of vanadium mixed ligand complexes with 8-hydroxyquinoline (L1) and L-amino acids such as L-cystein (L2), L-phenylalanine (L3) etc. have been studied at 0.1 M ionic strength in 70% methanol-water medium. Experimental works have been done through digital pH meter and calculation parts have been done by Bjerrum method. It is observed that metal vanadium ion form a complexes with (L1) 8-hydroxyquinoline and (L2) L-amino acids in 1:1:1 proportion. The values of metal ligand stability constant (log k) during formation of complex were estimate and compare with literature data. The effects of various amino acids bonded to central metal vanadium were studied from estimated data.

**Keywords:** 8-hydroxyquinoline, L-amino acids, Vanadium, metal ligand stability constant (log k), pH-meter.

### I. INTRODUCTION

The stability of complexes means in a most general sense, the complex exist under suitable conditions may be stored for a long period of time. However when the formation of complexes in solution is studied, they are having two types of stabilities, thermodynamic stability and kinetic stability [1,2].

Stability constant of mixed ligand alkaline earth metal complexes with metal ion was studied by Banarjee et al [3] many workers study the effect of transition metal on stability of complexes in pH metrically [4, 5] the studies of metal ligand complexes in solution having number of metal ions with ligands carboxylic acids, oximes, phenols etc. would be interesting which through a light on mode of storage and transport of metal ions in biological kingdom [6] metal complexation not only brings reacting molecules together to give activated complexes but also polarized electrons from the ligands towards the metal [7] Naik et. al [8] carried out pH metric studies on formation constant of complexes of substituted pyrazoles with some lanthanide metal ions and the influence of ionic strength of on complex equilibria in 70% dioxane-water mixture. Altun et al [9] has reported the potentiometric studies on Ni (II), Co (II) and Zn (II) with Schiff base in 60% dioxane-water mixture. Nilesh et. al [10] reported pH metric studies on stability constant of bromophenyl amino and iodophenyl amino substituted isoxazole with lanthanide metal ions in 70% ethanol-water mixture. In the language of thermodynamics the equilibrium constant of complex formation reaction are the measures of the heat released in the reaction and entropy change during complex formation reaction [11]. The greater



amount of heat evolved in the reaction most stable are the complexes. Secondly the increase in entropy during complex formation reaction, greater is the stability of product of complexes. Here we are mainly concerned with the thermodynamic stability of the complex compound [12-14].

In present article deals with stability constant study of 8-hydroxyquinoline ( $L_1$ ) and L-amino acid ( $L_2$ ) with V(II) metal ions in 70% methanol-water mixture.

## II. MATERIALS AND METHODS

All chemicals used are of AR grade. The ligands ( $L_1$ ) and ( $L_2$ ) were purchased from Babaji traders Parbhani recrystallise it before use. The stock solutions of the ligands and metal ions were prepared by dissolving required amount of compounds in 70% methanol-water mixture.

General Procedure:

Types of Titrations: (Total volume 25 ml)

- i) Free acid  $HClO_4$  (0.01M)
- ii) Free acid  $HClO_4$  (0.01M) + ligands (0.002M)
- iii) Free acid  $HClO_4$  (0.01M) + ligands (0.002M) + Metal ion (0.0004M) against standard 0.1N KOH solution.

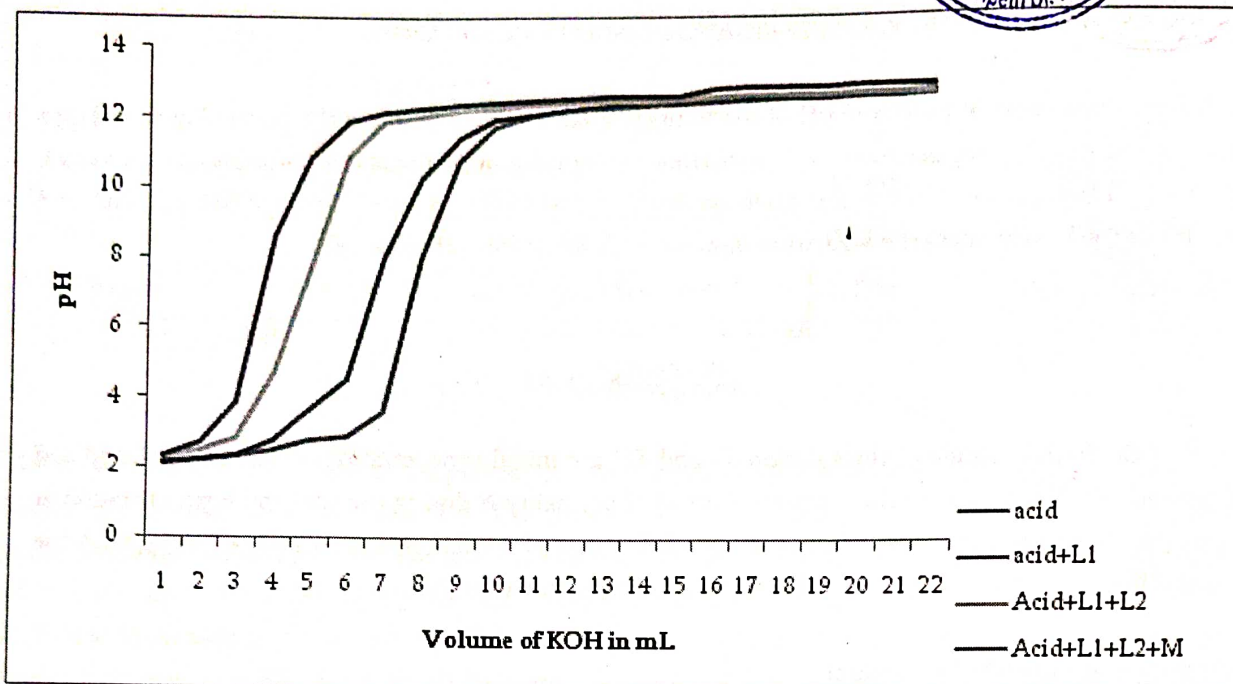
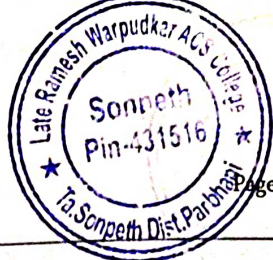
All the titrations were carried out in 70% methanol-water mixture and readings were noted down for each 0.5ml addition of KOH. The graph of alkali added against pH values was plotted. The ligands involved in the present work may be considered as a monobasic acid having only one dissociable proton ion from acidic group of amino acids and it can therefore, be represented as HL. The dissociating equilibria can be shown as.

## III. RESULTS AND DISCUSSION

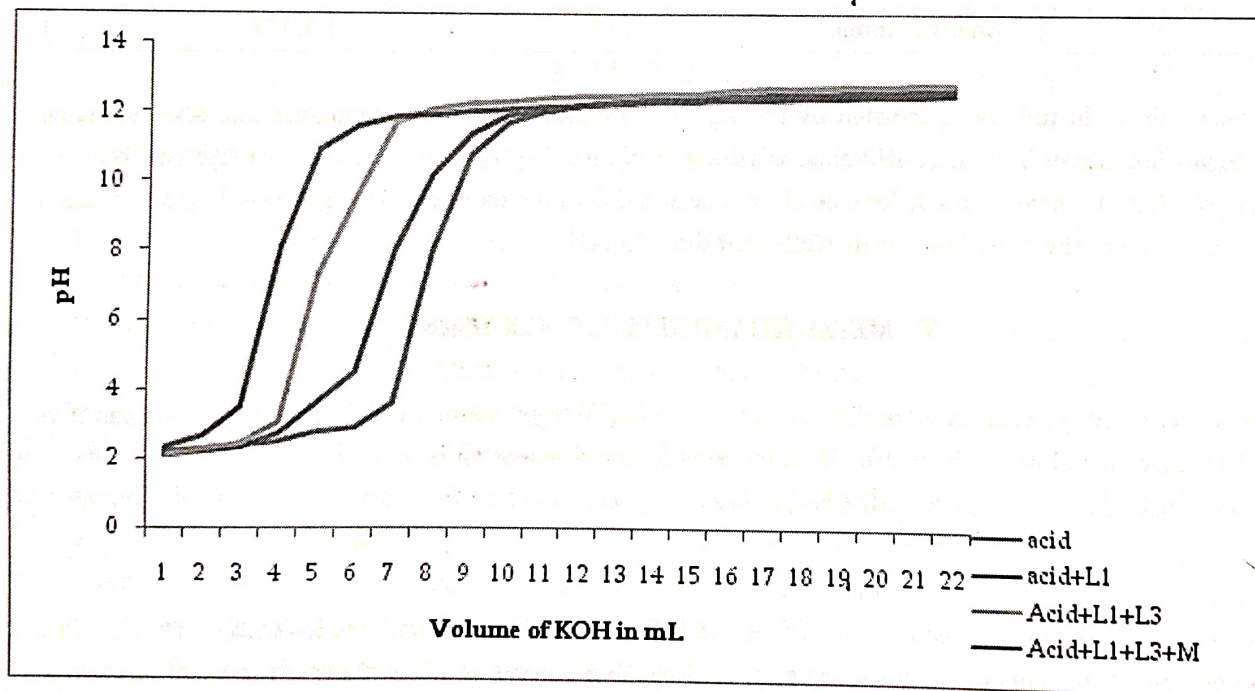
The graphs 1 and 2 indicates acid curve, acid with ligands 8-hydroxyquinoline ( $L_1$ ) and L-Amino acids ( $L_2$  &  $L_3$ ) curve and acid+ ligands+ metal curves between pH vs volume of KOH added for  $L_2$  and  $L_3$  Ligands respectively. The titration curves indicate pH values of acid curve is lower than pH values of ligand curve and metal curves at the same volume of KOH added. This is due to the amino acids do not form cation easily of free acid resulting in the decrease in the  $H^+$  ion concentration. The ligand 8-hydroxyquinoline has only one dissociable proton from  $-OH$  group and also in L-amino acids have only one dissociable proton from  $-OH$  group of side chain. The proton dissociation constant for HL have been calculated by using following equation.



$$K = \frac{[H^+][L^-]}{[HL]} \quad (2)$$



Graph 1: Acid curve, acid with ligands 8-hydroxyquinoline (L1) and amino acid L-cystein (L2) curve and acid+ ligands (L1+L2) + metal curves



Graph 2: Acid curve, acid with ligands 8-hydroxyquinoline (L1) and amino acid L-phenylalanine (L3) curve and acid+ ligands (L1+L3) + metal curves



#### IV. PROTON-LIGAND STABILITY CONSTANT

The plots between volume of KOH and pH of the solution were used to determine the proton ligand stability constant (representing the replacement of H<sup>+</sup> ions from functional group of ligand with respect to pH value). The horizontal difference (V<sub>2</sub>-V<sub>1</sub>) was measured accurately between the titration curves of free acid and acid + ligand. It was used to calculate the formation number  $\bar{n}_A$  at various pH values[8].

$$\bar{n}_A = \gamma - \frac{(V_2 - V_1)(N + E^0)}{(V^0 + V_1)TL^0} \quad (3)$$

Where, V<sup>0</sup> is the initial volume of the solution. E<sup>0</sup> and TL<sup>0</sup> are initial concentrations of the mineral acid and ligand respectively. V<sub>1</sub> and V<sub>2</sub> are the volumes of alkali of normality N during the acid and ligand titration at given pH.  $\gamma$  is the replaceable proton from the ligand. The data of  $\bar{n}_A$  obtained at various pH along with the horizontal difference for some representative systems are represented in Table 1.

Table-1: Proton ligand Stability constant

Ligand	System	pK	
		Half integral method	Point Wise Method
L2	L-cystein	2.015	2.136
L3	L-phenylalanine	2.098	3.009

The pK values of ligand was calculated by the algebraic method point wise calculation and also estimated from formation curves by noting pH values of titrations of ligands [12]. The values of L<sub>2</sub> (L-cystein) is lower than L<sub>3</sub> (L-phenylalanine). This difference of pK values is due to the more electronegative -SH group present in L<sub>2</sub> it is decreases the rate of proton displacement than ligand L<sub>3</sub>.

#### V. METAL LIGAND STABILITY CONSTANT

Metal ligand stability constant were determined by the half integer method by plotting graph between  $\bar{n}$  vs pH. The experimental values  $\bar{n}$  are calculated by using following equation [12].

$$\bar{N} = \frac{(E^0 + N)(V_3 - V_2)}{(V^0 + V_2)T_m} \quad (4)$$

Where E<sup>0</sup> and T<sub>m</sub> denotes concentration of free acid and concentration of metal ion in reaction mixture, V<sub>2</sub> is the volume of alkali added to reach the same pH reading, V<sub>3</sub> is volume of alkali added in the metal titration to attain the given pH reading, V<sup>0</sup> is the initial volume of reaction mixture and N is the concentration of sodium hydroxide solution. The metal ligand stability constant is shown in Table-2 as follow.

System	Metal ligand stability constant			
	Log K1	Log K2	$\Delta$ Log K	K1/K2
V(IV) + L <sub>1</sub>	4.3205	2.5678	1.7648	1.5428
V (IV)+L <sub>1</sub> +L <sub>2</sub>	3.1615	2.0262	0.4236	1.0097
V (IV)+L <sub>1</sub> +L <sub>3</sub>	3.4263	2.2025	1.2758	1.2365

## VI. CONCLUSION

The present work is observed that the pH metric curves of vanadium metal ion with 8-hydroxyquinoline (L<sub>1</sub>), L-cystein (L<sub>2</sub>) and L-phenylalanine (L<sub>3</sub>). The curves (A+L<sub>1</sub>), (A+L<sub>1</sub>+L<sub>2</sub>), (A+L<sub>1</sub>+L<sub>2</sub>+M) and (A+L<sub>1</sub>+L<sub>3</sub>+M) are started from the pH 1.92 to 2.16. The color of reaction mixture is change from colorless to dark balck in the pH range from 7.25 to 8.85 during titration it indicates complex formation between metal and ligand. The logK<sub>1</sub> and logK<sub>2</sub> values of L<sub>1</sub> And L<sub>1</sub>+L<sub>2</sub> with vanadium metal is lower than L<sub>1</sub>+L<sub>3</sub> due to in L-cyctein (L<sub>2</sub>) has more electronegative -SH group which decrease the activity of ligand to form more stable complex also the difference between logK<sub>1</sub> and logK<sub>2</sub> is greater in (L<sub>1</sub>+L<sub>3</sub>) system than (L<sub>1</sub>+L<sub>2</sub>) but less than (L<sub>1</sub>) it indicates vanadium metal form stable complex with L-phenylalanine amino acid (L<sub>1</sub>+L<sub>3</sub>) system than L-cystein (L<sub>1</sub>+L<sub>2</sub>) ligands.

## VII. REFERENCES

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