Studies on thermodynamic stability constant of amino acids with Yb(III) complexe.

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Abstract

The thermodynamic stability constant of the complexes were also calculated. The formation of complexes has been studied by Job's method. The results obtained of stability constant were good agreement. The metal-ligand and proton–ligand stability constant of Gd(III) with amino acids (L-GLutamic acid + serine) were determined at various ionic strength in 1% potassium chloride solution by pH metric titration. $NaClO_4$ was used to maintain ionic strength of solution.

Key word: Amino acid, Stability constant, ionic strength.

Introduction

Glutamic acid is considered as the essential amino acid for the protein synthesis. Glutamic acid offers the several health benefits and maintains the healthy functioning of body. It supports the good health of immune system, digestive system as also aids in the energy production in the body. Nehete et al have studied the effect of ionic strength on stability of complexes[1]The effect of ionic strength of medium on stability constant of cu (II) complex of 2-amino-5- Chloro benzene sulphonic acid at 301K[2]. The stability constant of Co (III) with 1-Amidino-0-methylurea as primary ligand at different ionic strength [3]. The influence of ionic strength of medium on complex equilibria [4]. Association and dissociation constant of Pr (III) complexes with 3-(2-hydroxy-3-Iodo-5-methyl phenyl) 1, 5 diphenyl pyrazoline at different ionic strength[5]. Stability constant of vanadium with glycene at various ionic strength by potentiometric titration technique [6] . The stability constant of Mo (IV) with Iminodiacetic acid at different ionic strength maintain by using sodium per chlorate was investigated [7]. Effect of ionic strength and solvent effect on thermodynamic parameters [8]. They have also studied the mechanism of protonation and complex formation of binary complexes of La (III), Ce (III), Pr (III) and Nd (III) with aminopyridines. The apparent metal-ligand stability constants and confirmation of complexes studied [9] .The composition of complexes were confirmed by Job's method as modified by Vasburgh and Gold [10].

In this work, we have determined the pK, metal-ligand stability constant at different ionic strength. We have studied in the 1% potassium chloride. We have thought of interest to study the effect of ionic strength on thermodynamic parameters of complexes of L-GLutamic acid with Gd(III) metals in 1% sodium benzoate by pH metrically and spectrophoto metrically.

Experimental

The pH measurements were carried out with equip-tronic EQ-610 pH meter (accuracy ± 0.01 units) using combine glass electrode at 208 K. Pure rare earth nitrate (99.9% Pure) was used. Metal nitrate available from Sigma Aldrich Chem. Co., U.S.A. Metal nitrate was prepared in triply distilled water and concentration was estimated by standard method. The solution of amino acid was prepared in 1% potassium chloride. The pH metric readings in 1% potassium chloride were converted to $[H^+]$ value by applying the correction proposed by Van Uitert Haas. The overall ionic strength of solution was constant maintains by adding $NaClO_4$. All the solutions were titrated with standard carbonate free NaOH (0.2N) solution at different ionic strength. The titration was carried out at ionic strength by adding $NaClO_4$ (0.02, 0.04, 0.06, 0.08 M)

The experimental procedure involved pH metric titrations of solutions of –

1) Free $HClO_4$ (A)
2) Free $HClO_4$ + Ligand (A+L)
3) Free $HClO_4$ + Ligand +Metal ion (A+L+M)

Data obtained from each titration is plotted as pH Vs volume of NaOH added and corresponding volume at successive pH for each set is determined and calculated. The metal–ligand stability constant of lanthanide metals complexes with amino acid were investigated spectrophoto metrically. The absorbances measured were carried out with Shimadzu UV-1800 ENG 240V, Japan spectrophotometer. $NaClO_4$ was used for maintaining the constant ionic strength. The different composition of metal ion ($1x10^{-4}$M) and ligand ion ($1x10^{-4}$M) were prepared in ten series. For determination of $\lambda_{max,}$ 50% metal ion solution at which maximum absorbance observed. The absorption of all composition was measured at constant wave length (λ_{max}) and at constant pH.

Result and discussion

In the present investigation the dependence of proton-ligand stability constant and metal-ligand stability constant on ionic strength of medium was examined by taking fix concentration of metal nitrate and ligand solution during pH metric titration. The system has been studied at 0.02, 0.04, 0.06, 0.08M ionic strength by varying the concentration of sodium per chlorate. The total ionic strength of medium is calculated by equation.

$$\mu = \Sigma\ 1/2\ \mathbf{C_i Z_i^2}$$

C_i , Z_i are the concentration and valences of i^{th} ion respectively.

The values of proton–ligand and metal-ligand constant of Gd(III) at different ionic strength 0.02,0.04,0.06 and 0.08M determined. These values were determined by using Irving-Rossotties method. From table-1, it was seen that the values of proton–ligand stability constant (P^K) decreases with increasing ionic strength of medium. The metal-ligand stability constant (logK) also decrease with increasing ionic strength.

The conditional stability constant of amino acid–lanthanide metal complexe were determined for all systems by using equation.

$$K= x / (a_1-x) (b_1-x) = x / (a_2-x) (b_2-x)$$

K= stability constant, x = Concentration of complex, a_1 and b_1 were concentration of metal ion and ligand before dilution. a_2 and b_2 were concentration of metal ion and ligand after dilution. The values of 'x' were calculated from graph optical density Vs % composition of metal ions in solution.

From table-2, it was seen that the good agreement among thermodynamic constant obtained from pH metry and spectrophotometrically.

Table1. Proton–ligand (pK) and metal-ligand stability constant (Log K) value for Yb(III) with amino acids at various ionic strength(μ)

μ	√μ	√μ/1+√μ	[√μ/1+√μ] –0.3√μ	pK	$LogK_1$	$LogK_2$
L-GLutamic acid **+ Yb(III)**						
0.02	0.1414	0.1239	0.0815	7.6167	6.15	3.50
0.04	0.2000	0.1667	0.1067	7.6458	5.50	3.25
0.06	0.2450	0.1968	0.1233	6.8842	5.35	2.75
0.08	0.2828	0.2205	0.1356	5.6448	4.70	2.60

Table 2. Metal-ligand stability constants (Log K) values obtained by pH-metry and Spectrophotometry technique (Ionic strength = 0.08m)

System	pH metry	Spectrophotometry
Yb (III)+ L-GLutamic acid	4.55	4.5257

Conclusion

The calculated values of stability constant at various ionic strength are high. From data the conclusion is, the complexes of amino acid with Gd (III) metal ion were quite stable at over all range of ionic strength. The values of conditional metal-ligand stability constant shows good agreement with the values determined by pH metrically.

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References:-

1. Nehete j.p., Waghulde G.P. and Sonar A.N., Ultra Chemistry Vol. 8(2), 239-242 (2012).
2. Deosarkar, S.D., Narwade, M.L., Hiwase, V.V. and Khedkar, K.M., 2009. Ori. J. Chem., 25(1):233.
2. Saroda devi and Singh, M., 2007. J.Ind.Coun.Chem, 24 (2):32-35.
3. Agrawal ,P.B., Narwade and M.L. , 2003. Acta Ciencia Indica , XXIXC(2):141.
4. Mehram, Y.K., Mandakmare, A.U. and Narwade, M.L., 2000. Orien. J. of Chem., 16 (1): 173-176.
5. Khorrami, S.A., Bayat, H., Sharifi, S. and Shafai, M., 1996. *J.Chem.Eng.data*, 41(6): 1322-1324.
6. Majlesi, K., Gharib, F. and Arafati, M., 2006. J.Inorg.Chem. 51(2):1982-1986.
7. Sharma, S.,Shah, M.C.,Dalwadi, D., Thakur,F. and Vora, J.J., 2008. Research J. of Chem.and Envi., 12(4): 29-34.
8. Vogel's, G.H., Jaeffery, S., Bassetl, Denney, R.C.,"Text book of quantitative chemical analysis". **Vth** Ed., ELBS Longman, 53 (1997).
9 Tekade P. V., Patil K. N. and Narwade M. L., 2006. Asian J. of Chem., 18(4)**:** 2657.
10. Gold K. R. and Vasburgh W. C., 1942 .*J.*Am. Chem. Soc., 64:1630.
12. Rahman, F., Rastogi S.N. and Jettey, U.K., 1990. J. Ind.Chem.Soc., 67:342.