Available online at **www.joac.info**

ISSN: 2278-1862

Journal of Applicable Chemistry

2018, 7 (5): 1172-1174

(International Peer Reviewed Journal)

Studies the Influence of Dielectric Constant of Medium on Stability Constants of Clobetasol propionate and its Complexes with Gd(III) Ion

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Accepted on 6th August, 2018

ABSTRACT

The solution studies of binary complex of Clobetasol propionate with Gd(III) ion have been performed. The protonation constant of clobetasol propionate and the stability constant of complexes with Gd (III) ion at 303.15K were investigated. The ionic strength is constant maintained 0.01M by adding $NaClO_4$. The pK and logK values of the complexes were determined in 10% to 50% ethanol - Water medium by the pH metric method. The pK and logK values of the complexes increased as ethanol content increased.

Keywords: Stability constant, Dielectric constant, Protonation constant.

INTRODUCTION

Clobetasol propionate is used for the treatment of various skin disorders including eczema, herpes labialis [**1**]**.** The lanthanide compounds have a remarkable importance in daily life [**2-3**]. The influence of dielectric constant on complex equilibrium between substituted pyrazilines and lanthanide metal ions in dioxane-water systems have been studied [**4**]. The stability constant of lanthanides and Iminodiacetic acid in water and dioxane-water mixture have been studied by potentiometric method at constant ionic strength [**5**]. The dissociation constant of Succenic acid, Azelic acid, Acetic acid in methanol-water, Ethanol-water, dioxane-water system at different dielectric constant have been studied [**6**]. The stability constant of 4-Amino, 3-Napthol Sulphonic acid with Cu(II) metal ions in different dielectric constant of medium using ethanol-water system by pH metry was studied [**7**]. Omar H. Al-Obaidi have been studied the stability constant of metal complex with flavone by spectrophotometry [**8**]. Reddy *et.al.*, have showed the effect of dielectric constant on the stability constant of Co(II) and Ni(II) with two mercaptoethyl benzimidazole , glycene , ehtelene diamine and salycilic acid in various properties of ethanol-water mixtures at 30°C and ionic strength is 0.1M [**9**].

The present work describes the complexation of Gd(III) with ligand in 0.01M ionic strength. The present work includes the determination of pK and logK values at various percentage of ethanol-water medium.

MATERIALS AND METHODS

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. All metal nitrates available from Sigma Aldrich Chem. Co., U.S.A. Metal nitrate was prepared in triply distilled water and concentration was estimated by standard method. All chemical reagent used in this work are A.R. grade. The solution of drug was prepared in ethanol .The pH metric readings in different percentage (10%, 20%, 3%, 40%, 50%) of ethanol –water mixture were converted to $[H^+]$ value by applying the correction proposed by Van Uitert Haas. The overall ionic strength of solution was constant maintained by adding $NaClO_4$. All the solutions were titrated with standard carbonate free NaOH (0.2N) solution at constant ionic strength. The titration was carried out in different percentage (10%, 20%, 3%, 40%, 50%) of ethanol-water medium. The values of dielectric constant of different percentage of ethanol-water had taken from M. Faraj *et al* [**10**]. Data obtained from each titration was plotted as pH Vs volume of NaOH added and corresponding volume at successive pH for each set was determined and calculated.

RESULTS AND DISCUSSION

The proton-ligand and meta-ligand stability constant of cortisone and its complexes with Gd(III) metal ions are given in table 1. It could be seen that pK and logK values increased with increase in the percentage of ethanol with decrease in dielectric constant of medium, this is due to the interaction between lanthanide ions and ligand is mainly electrostatic, as well as because of the effect of bulk solvent. The lowering of dielectric constant would increase the electrostatic force of attraction between metal ion and negatively charged ligand to form complex. The values of pK were calculated by point wise calculation method. The metal-ligand stability constants were determined by half integral method. Higher values of $logK_1$ and log K_2 showed that ligands are stronger chelating agents. The dielectric constant of medium strongly affected on proton-ligand and metal-ligand stability constants because of the fact that at least one of the constituent is charged and other is either charged or has dipole moment. The plots of log K_1 and log K_2 vs 1/D for the entire system exhibit a linear relationship (Fig. 1 and 2).

Table 1. pK and LogK values of ligand and its complexes with Gd(III) in different percentage of Ethanol-water mixtures at 0.01 ionic strength

% Ethanol	Dielectric constant (D)	1/D	Mole-fraction	ligand	ligand + Gd (III)	
				pK	$LogK_2$	$LogK_1$
10	73.95	0.01352	0.0228	5.9652	5.89	4.30
20	69.05	0.01448	0.0499	6.4987	6.65	4.65
30	63.85	0.01566	0.0825	6.8972	6.85	4.76
40	58.36	0.01714	0.1227	7.1947	7.60	4.85
50	52.62	0.01900	0.1735	7.5049	7.98	5.14

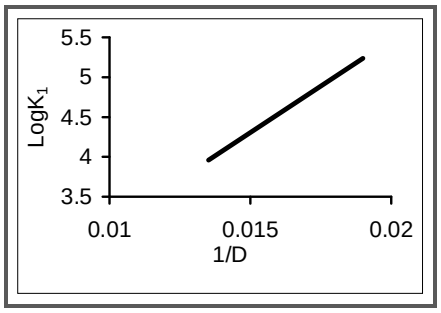

Figure 1. Plots of $LogK_1$ Vs 1/D

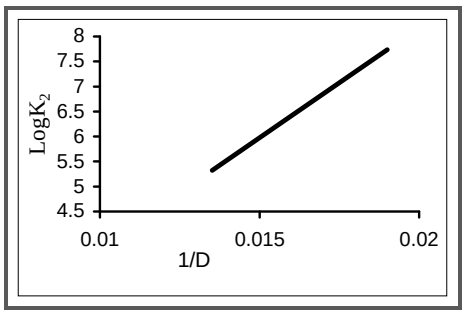

Figure 2. Plots of $LogK_2$ Vs 1/D

APPLICATION

Stability constant is well known tool for solution chemist, biochemist, and chemist in general to help determine the properties of metal-ligand reactions in water and biological system. In the detection and determination of inorganic ions, various organic and inorganic chelating agents are useful. Sometimes chelating agents form inner complexes with metal ions, which are sparingly soluble.

CONCLUSION

The proton-ligand and metal-ligand stability constant of complexes increased with increased percentage of ethanol. The values of dielectric constant of medium was decreases, with increasing the values of proton-ligand and metal-ligand stability constant of complex. The dielectric constant of medium decreased, as expected from the electrostatic nature of interaction between metal ions and ligands.

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