pH-Metric Measurements of Picolinic Acid with Transition Metal Ions At 0.1 M Ionic Strength

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Abstract

Proton-ligand stability constants and metal-ligand stability constants of picolinic acid were studied with transition metal ions and were determined by pH-metric study at 0.1 M ionic strength.1:1 complexes were formed in between picolinic acid (PA)and transition metal ions. Values of pK and log k were evaluated and compared from resultant data.

KEYWORDS-pK and log k values, pH-metric study, PA, transition metal ions.

Introduction

Medicinal and biochemical application as well as significances of compounds can be easily studied by knowing stability constants of that molecule. At the same time formation of complex can also be determined from these values, for this reason pH-metric results are considered as one of the prime factor for determination of pharmaco dynamics and pharmacokinetics of any molecule. Picolinic acid is important organic molecule in medicinal, chemical and life sciences Grant et al (2009). Potency of drugs can be increased by changing metal ion in complexes Irving et al.(1954). Nitrogen and sulphur containing heterocycles are the best ligands Martell et al.(1952) . pK and log k values of mixed ions were reported by Phase et al. (2013**)** at the same time pK and log k values of Cu(II)-salicylic acid and Mn(II) was studied by Naik et al. (2009) and Cu(II), Fe(III) by Mane et al.(2011), Khambre et al. (2014**)** studied complexes of Pr (III), Nd (III) and Gd (III) of substituted Schiff's bases and dibromochalcones. So pK and log k values of picolinic acid with transition metal ions at 0.1 M ionic strength was determined by pH-metrically.

Materials and Method

Picolinic acid (PA) was gifted from pharmacy department of our college and used as ligand. Nitrates of transition metal ions were taken. Stock solutions were prepared in water. Titrations of **(**i) free acid, (ii) free acid and ligand and (iii) free acid, ligand and metal ion against standard 0.1N NaOH solution were carried out. Ionic strength of all the solutions was maintained constant by adding appropriate amount of 2 M solution KNO_3. All the titrations were carried out in water and readings were recorded for each 0.2 ml addition. Graph of volume of alkali added against pH were plotted.

Results and Discussion

Calculation of ($\bar{n}_A$) and ($\bar{n}$)

Calculation of $\bar{n}_A$ at various pH values were determined by using an equation given below,

$$\bar{n}_A = \gamma - \left\{ \frac{(V_2 - V_1).\left(N + E^0\right)}{\left(V^0 + V_1\right)T_L^0} \right\}$$

$\bar{n}$was determined by using equation following equation,

$$\bar{n} = \frac{(V_3 - V_2) \times ((N + E^0)}{(V^0 + V_2) T_M^0}$$

$\bar{n}_A$ and $\bar{n}$ values obtained during study are given in **Table-1**

Table-1

$\bar{n}_A$ Values				$\bar{n}$ Values		
Sr. No.	PA-Cu(II)	PA-Co(II)	PA-Fe(II)	PA-Cu(II)	PA-Co(II)	PA-Fe(II)
1	0.6336	0.4334	0.4518	0.1783	0.6394	0.8318
2	0.3294	0.3937	0.4119	0.4699	1.3957	1.0677
3	0.2314	0.3541	0.3722	0.5820	1.4998	1.1421
4	0.1974	0.2338	0.2514	1.0593	1.6429	1.7548
5	0.1600	0.2149	0.2514	1.3723	1.8529	2.0043
6	0.0435	0.1358	0.1495	1.4822	2.0046	2.0434

pK values were determined by half integral and point wise calculation methods and found to be 3.645 and 3.837 respectively while log K values are given in **Table-2**.**Table-2**

System	**Log K_1**	**Log K_2**	**Δ Log K**	**Log K_1/Log K_2**
PA+Cu(II)	3.2547	2.2775	0.9772	1.4240
PA+Co(II)	3.8546	2.2775	1.5771	1.6924
PA+Fe(II)	4.1547	2.3775	1.7772	1.7475

Conclusion

Study of pharmacodynamic and pharmacokinetic parameters of any molecule (drug) is essential before recognizing it as drug. With the help of pharmacodynamic study we can predict drug activity and drug effect. There are four steps as drug absorption, drug transmission (diffusion), metabolism and excretion. In drug absorption and drug transmission (diffusion) the stability of drug is essential and it can be studied easily by pH-metric measurements, hence this study was carried out. For pH-Metric study we require minimum chemicals that are easy to handle, safe and which give accurate results. In this study we found that, curve for all systems nearly started from pH = 4.5-4.6 to 11 indicating formation of complex between metal and ligand. Order of pK values of ligand gave indication towards deprotonation of ligand having good activity to form more stable complex. Less difference in between log K_1 and log K_2 values indicated occurring of simultaneous complex formation between metal ion and ligand as given in Table-2, these values showed 1:1 complexation in between above metal ions and PA. These values also decided the stability of complexes.

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