



Studies of binary complexes of bivalent metal ions with Nicotinic acid by Potentiometry

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ABSTRACT

The binary complexes of metal ions Co^{2+} , Ni^{2+} , Cu^{2+} , Zn^{2+} and Cd^{2+} with Nicotinic acid as a ligand are studied in aqueous media using Irving Rosotti method. Acidity constant and stability constant are studied at 27°C at ionic strength 1N NaNO_3 . Stability constants calculated by half integral method and point wise method are compared and found to follow Irving and Williams rule.

Keywords: Stability constant, Binary complex, Bivalent metal, Nicotinic acid, Potentiometry.

1. INTRODUCTION

Nicotinic acid is a member of B group vitamin. It is a water soluble vitamin that is derived from pyridine with a carboxyl group at 3-position. The generic name of Nicotinic acid is niacin. Nicotinic acid is a digestive aid that helps body to derive energy from carbohydrates, fats and proteins. This vitamin B_3 does not free in the body because human body do not have ability to synthesize sufficient nicotinic acid. This compound is essential component of balanced diet, such as wheat, yeast, pork and beef liver. Although nicotinic acid is present in food, the majority of niacin is produced synthetically by chemical oxidation or am oxidation of alkyl pyridines.

In vivo, nicotinic acid is needed to synthesis co-enzymes; nicotinamide adenine dinucleotide (NAD) and nicotinamide adenine dinucleotide phosphate (NADP) that are used by dehydrogenase in tissue respiration. The main function of nicotinic acid is as a lipid lowering agent to prevent heart disease and stroke. As a lipid lowering agent, nicotinic acid works by reducing the amount of LDL and triglycerides that are made by liver. It has unique pharmacological properties for arthritis, asthma, diabetes and anti aging reagent. The deficiency disease caused is called as pellagra. This disease affects the gastrointestinal tract, lesions on skin and central nervous system. The symptoms of pellagra are dermatitis, diarrhea and even mental disorder [1]

Over the years there has been a steadily increasing interest in studying binary complexes of pyridine derivatives arising part due to physiological properties. The importance of pyridine carboxylic stems from their presence in many natural products such as alkaloids, vitamins, coenzymes. These compounds are of a particular interest to medicinal chemists because of wide variety of physiological properties displayed by

natural and synthetic acids. Moreover, many of pyridine carboxylates are versatile ligands and their complexes with some metal ions have been use in medicine and quantitative analysis [2].

Literature survey reveals that workers [3, 4] have worked on complexation of this ligand. But work done is not sufficient therefore we have undertaken the work.

2. MATERIAL AND METHODS

For the present investigation, Nicotinic acid used as ligand was of AR Grade SD fine. Sodiumhydroxide, Sodium Nitrate, Metal nitrates, Nitric acid used of AR Grade SD fine and prepared in double distilled water. Buffer solution of pH 4 and pH 7 are used for calibration. The relative stabilities of the complexes formed were investigated potentiometrically adopting Irving and Rossotti⁵ pH-titration technique. pH metric measurements carried out using Elico digital pH meter model L-120 with combined glass electrode. The ionic strength was maintained using 1N NaNO_3 . Proton ligand and stability constants are determined using SCOGS computer programme.

2.1. Procedure

The following solutions are prepared (total volume 50ml) and titrated potentiometrically against standard NaOH (0.2N) solution.

- HNO_3 (2ml) + NaNO_3 (2ml)
- HNO_3 (2ml) + ligand (2ml) + NaNO_3 (2ml)
- HNO_3 (2ml) + ligand (2ml) + Metal solution (2ml) + NaNO_3 (2ml)

3. RESULTS AND DISCUSSION

The results obtained are analyzed by the computer programme and the stability constant values are calculated.

Graph of navs. for proton ligand system was plotted and found to extend between 0-1 indicates that ligand has one replaceable proton. Ligand titration curve had a lower pH value than acid titration curve. Displacement of ligand titration curve along volume axis with respect to acid titration curve is indication of proton dissociation. Values of n obtained are within range 0.2-0.8 indicating formation of 1:1 complexes. Deviation of A+L curves from A+L+M curves indicates formation of complex.

Proton Ligand Constant and Stability constants of binary complexes of bivalent metal ions with Nicotinic acid

Sr.no	Metal ion	logk1
1	Cu ⁺²	3.722
2	Zn ⁺²	3.653
3	Ni ⁺²	3.632
4	Co ⁺²	3.600
5	Cd ⁺²	3.510

The order of stability is Cu > Zn > Ni > Co > Cd. The stability constant of divalent metal ions with above ligand increases with decreasing atomic size, with copper as exception due to Jahn Teller effect. The order is in agreement with Irving-Williams's order [5] of stability and the order is observed by many

workers [6-9]. The stability constant value varies with the ionic size of metal ion. The smaller the ionic radius of the central atom, more stable is the complex formed. It also depends upon experimental conditions used. The additional high stability of the copper complex is due to unique electronic configuration which is capable of additional stabilization due to Jahn-Teller effect.

4. REFERENCES

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