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Stability constants of Nicotinic acid (vitamin B3) complexes with transition metal ions

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Abstract

Vitamins play very important role in human and animal bodies. They have great significance of complex formation with transition metal ions. The water soluble vitamin B3 i.e.Nicotinic acid is a ligand which forms complexes with transition metal ions. The stability constants of Nicotinic acid complexes with transition metal ions V(II),Cr(II),Fe(III),Co(II),Ni(II),Cu(II)& Zn(II) were determined pH metrically, at temperature 298K (25^0C) in Methyl alcohol-water and Ethyl alcohol-water medium at an ionic strength 0.1M $NaClO_4$. The proton - ligand stability constant pk_1 and metal-ligand stability constant log K_1 have been calculated. The resultant values of stability constants in both the medium were compared and discussed. It is concluded that the stability constant values are greater in Methyl alcohol-water medium than the Ethyl alcohol-water medium

Keywords: Nicotinic acid, stability constants, binary complexes, transition metals.

1. Introduction: Nicotinic acid (VitaminB3) 3-pyridinecarboxylicacid

Nicotinic Acid is a water-soluble vitamin. It exists in two forms as nicotinic acid and nicotinamide. It is also known as niacin which can beexists as nicotinamide adenine dinucleotide (NAD) and its phosphate (NADP) which function dehydrogenase-reductase system requiring transfer of hydride ion [1,2]. NAD is also required for non-redoxadenosinediphosphate - ribose transfer reaction [3]. NADP functions in reductive biosynthesis such as fatty acid, steroid synthesis, and in the oxidation of glucose 6phosphate to ribose - 5 phosphate. Source of vitamin B3 iscereal grains, animal liver, fish and yeast. Its dietary deficiency causes chronic wasting disease pellagra [4]. Its chemical formula is C_6 H_5 $N0_2$. and Mol. wt. is 123.1In transition metalcomplexes, the formation of a coordination bond can be considered as a transfer of a lone pair of electrons from the coordinated group or ligand to the metal ion [5]. Thus, in order to determine the stability constants of vitamin B3 complexes research work has been done by using mix solvent medium Methanol-Water and Ethanol-Water by maintaining ionic strength 0.1M $NaClO_4$ and constant temperature 298K.(25^0C)

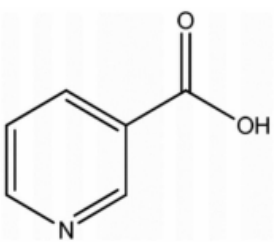

Fig.1.Nicotinic acid (Vitamin B3)

1 Materials and Method:

1.1 Materials:

All chemicals were used are Analar grade. Ligand sample of Nicotinic acid (vitamin B3) was used in pure form. The solution of $NaClO_4$prepared in distilled water. Metal ions were used in the nitrate form. The 0.1MNaOH was standardized against standard oxalic acid. The ionic strength was maintained at 0.1M by using $NaClO_4$. The ligand solution of Nicotinic acid was prepared in aqueous medium.

1.2 Method:

The potentiometric titrations are performed by using an Elico model LI-120 digital pH meter in conjunction with an Elico combined glass electrode consisting of glass and reference electrode.The precautions suggested by Bates[6], Alber and Sergent[7] were adopted for smooth handling of electrode.

The pH meter standardized using buffer solution. By adopting standard procedure, all titrations were carried out at constant temperature. The ligand solution and acid solution were transfered into 100 ml beaker and titrated against std. NaOH solution. The Potentiometric titrations was performed in aquo-organic medium first without addition of metal and then in presence of transition metals V(II), Cr(II), Fe(III), Co(II),Ni(II),Cu(II), and Zn(II) by maintaining ionic strength 0.1M $NaClO_4$ and 298 K constant temperature.The Proton ligand stability constants andMetal ligand stability constants are shown in Table 1 and Table 2 as below.

Table 1.Proton ligand stability constants of Nicotinicacid (vitamin B3) in different mixture of solvent Medium – 36%Methanol-Waterand 30% Ethanol-Water

μ=0.1Temperature- 298K

Proton Ligand ability constants	36%MeOH-Water	30%EtOH-Water
pK_1	5.23	4.57
pK_2	----	-----

Table.2. Metal ligand stability constants ofNicotinic acid (vitamin B3) in different mixture of solvents.

μ=0.1Temperature- 298K

Transition Metals	Metal Ligand stability constants	36%MeOH-Water	30%EtOH-Water
V(II)	$logK_1$	3.68	2.81
Cr(II)	$logK_1$	3.39	3.24
Fe(III)	$logK_1$	4.19	4.13
Co(II)	$logK_1$	3.26	3.19
Ni(II)	$logK_1$	3.09	3.05
Cu(II)	$logK_1$	2.59	2.49
Zn(II)	$logK_1$	2.81	2.49

Result and Discussion:

- The proton ligand and metal ligand stability constant of Nicotinic acid with transition metal ions at ionic strengths $NaClO_4$inmedium 36% MeOH-Water and 30% EtOH-Water is given in table1and 2.In Nicotinic acid one pK value is obtained. This is attributed to the dissociation of one enolic-OH groups. The pK_1 value in 36%MeOH-Water is 5.23 and in 30% EtOH-Water medium is 4.57 which is less according to Debye-Huckel theory.
- In case of metal ligand stability constants,the values of log K_1 decreases in 30% Ethanol-Water medium than 36%Methanol-Water medium. These indicating that in ethanol more acidic complex is formed than methanol.
- The order of stability constant of Nicotinic acid in 36%Methanol-Water medium is Fe>V>Cr >Co> Ni> Zn> Cu
- The order of stability constant of Nicotinic acid in 30% Ethanol-Water medium is Fe>Cr>Co>Ni>V>Cu = Zn
- All the above orderof stabilities of the metal complexes with the ligand show good agreement with the stability order shown by

workers [8,9] and others [10,11]

Conclusion:

In this research work pH metric study was performed to determine stability constants and to assess binary species for nicotinic acid with transition metals in aquo-organic medium. The following conclusions have been drawn.

1. Nicotinic acid forms complexes with transition metal ions in the pH range 1.98 to 11.98.

2. The one pK value ofnicotinicacid is due to presence of enolic(-OH) groups in it. The order of pK values in varying aquo-organic medium is 36% MeOH-Water > 30% EtOH-Water

3. The order for log K values for transition metals are 36% MeOH-Water > 30% EtOH-water

References

Book

[1]. McCormick D. B., Coenzymes, Biochemistry of In: Meyers RA, ed. Encyclopedia of Molecular Biology and Molecular Medicine, Vol1.Weinheim, VCH (Verlag Chemie) 396-406, (1996).

[2]. Mc Cormick D. B. Coenzymes, Biochemistry. In: Dulbecco R. ed. Encyclopedia of human biology, 2nd ed. San Diego, C. A. Academic Press, 847-864,(1985).

[3]. Berger N. A. Poly (ADP-ribase) in the Cellular Response to DNA Damage. Radiation Research, 101: 4-15, (1985).

[4]. McCormick D. B., Vitamin, Structure and function of In: Meyers R. A., ed Encyclopedia of Molecular Biology and Molecular Medicine, Vol.6, Weinheim VCH (Verlag chemie), 244-252, (1997).

Journal

[5]. Abdulbaset A.Zaid, Mazahar Farooqui, D.M.Janrao Der Chemica Sinica2012, 3(1), 64-70,(2012)

[6]. R.G. Bates, Determination of pH Theory and Practice: AWiley Interscience Publication. New York,(1973)

Book

[7]. [A. Albert, E.P. Serjeant, Determination of Ionisation Constants: Chapman and Hall Ltd., 2nd Edn, London, 10, (1971)

Journal

[8]. [D. P. Meller and L. E. Maley,Nature :154, 370, (1947)

[9]. D. P Meller andL. E Maley,Nature:161, 436, (1948)

[10]. Ram Nayan &A. K. Dey,*J.* Ind. Chem. Soc: L II, 1020, (1975)

[11]. H. L Karala. J. S Malik and V. J. Gera, Ind. Chem. Soc: L IX, 1427, (1982)