Asian Journal of Chemistry Vol. 5, No. 1 (1993), 221–223

Studies on Mixed-Ligand Complexes of Cobalt(II), Nickel(II), Copper(II) and Zinc(II) with Aminosubstituted Benzoic Acids and Nitrilotriacetic Acid

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The technique of paper electrophoresis was used to determine the stability constants of mixed ligand complexes of Co(II), Ni(II), Cu(II) and Zn(II) using 2-aminobenzoic acid (2-ABA), 3-aminobenzoic acid (3-ABA) and 4-aminobenzoic acid (4-ABA) as primary ligand and nitrilotriacetic acid (NTA) as secondary ligand at 25 ± 1°C at a fixed ionic strength μ = 0.1 M $HClO_4$, in aqueous solution.

INTRODUCTION

The role of mixed ligand complexes in biological process has been well recognised[1]. The knowledge of stabilities of these complexes are known to play an important role in many metabolic and toxicological functions. Several attempts have been made to correlate stabilities of the metal-ligand complexes with their biocidal activities[2,3]. Nitrilotriacetic acid (NTA) behaves as an unique tridentate or tetradentate ligand[4,5]. The present study was undertaken to observe the interaction of metal(II)-aminosubstituted benzoic acid complexes with NTA by paper electrophoresis. Co(II),- Ni(II),- Cu(II)- and Zn(II)- 2-aminobenzoic acid (2-ABA), 3-aminobenzoic acid (3-ABA) and 4-aminobenzoic acid (4-ABA) complexes have been reported earlier[6].

EXPERIMENTAL

All the chemicals used were prepared as earlier reported method[6]. However, the experimental procedure for the study of mixed complexes is little modified. To the background electrolyte containing primary ligand *viz.* 2-ABA, 3-ABA and 4-ABA in addition to perchloric acid, the secondary ligand i.e. NTA is progressively increased and the electrophoretic observation of the metal ion spot on paper strip is taken at every addition of the secondary ligand, pH being maintained at 8.5, reason of which has been explained earlier[7]. Stability constants were found out from the graphical representation of mobilities[7]. The values are presented in Table 1.

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RESULTS AND DISCUSSION

Two plateaus are obtained in all the mobility curves. Constant values of mobility in the first plateau corresponds to the mobility of M-(2-ABA), M-(3-ABA) and M-(4-ABA) complexes. The second plateau, however, corresponds to the mobilities of new complex. This new complex may be a mixed complex of the type M-L-NTA.

That the final plateau corresponds to the mobility of M-L-NTA is evident by its greater value of mobility than the mobility of M-NTA[7].

The stability constants of the different mixed complexes are reported in Table 1.

It is evident that the values follow the same order as in case of binary complexes[6], which is in good agreement with the Irving-Williams series[8].

The higher values in case of ternary complexes of 3-ABA than those of 4-ABA and 2-ABA and that of 4-ABA than 2-ABA are attributed to the stronger acidic character[6] of 3-ABA than 4-ABA and 2-ABA and that of 4-ABA than 2-ABA. It must be noted that higher values of stability constants in case of ternary complexes than binary complexes indicate their increased stability which is further supported by the work of Sillen and Martell[9].

TABLE 1

STABILITY CONSTANTS OF MIXED COMPLEXES

Temp. = 25 ± 1°C Ionic Strength 0.1 M $HClO_4$

Cations/Ligands	Co(II)	Ni(II)	Cu(II)	Zn(II)
M-(2-ABA)-NTA	3.26	3.56	3.68	3.08
M-(3-ABA)-NTA	4.56	4.68	4.86	4.38
M-(4-ABA)-NTA	3.96	4.08	4.26	3.86

ACKNOWLEDGEMENTS

The author is thankful to Prof. K. L. Yadava, Head, Department of Chemistry, Dr. S. R. Tripathi and Dr. R. K. P. Singh for providing laboratory facilities and their helpful counsel.

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[*Received*: 7 January 1991; *Accepted*: 19 March 1992] AJC-416