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USE OF LIGANDS FOR IMPROVED SEPARATION OF METAL IONS ON THIN SILICA LAYERS

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ABSTRACT

2,2' dipyridyl and iminodiacetic acid have been employed as impregnants for improving the separation of thirteen metal ions of interest using the solvent system Isoamyl alcohol-H₂O-AcOH (20:10:10) and MeOH-Benzene-AcOH (20:10:15). Metal ions have been divided into two groups as toxic metal ions and metal ions in vivo for a satisfactory separation.

INTRODUCTION

TLC separation of metal ions has been attempted by many workers on various adsorbents or on ion exchange resins¹. Ligands have been used for chelate formation prior to chromatography but little attention has been paid to the use of ligands as impregnants for improving the separation of metal ions. In this laboratory NTA², 8-OH-quinoline, dibenzoyl methane³ and other ligands have been tried as impregnants for the separation of metal ions. In the

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present paper 2,2' dipyridyl and iminodiacetic acid have been used for a satisfactory separation of certain toxic metal ions and metal ions in vivo⁴.

EXPERIMENTAL

The TLC plates of 0.5 m.m. thickness were prepared by spreading a slurry of a mixture of silica gel 'G' and 0.50% aq.

TABLE I

S.No.	Metal ion	Taken as	Solvent system ^I		Solvent system ^{II}	
			Plain	hR _f Imp*	Plain	hR _f Imp**
1	Cd ²⁺	Acetate	74	63	90LT	57
2	Cu ²⁺	Acetate	71	44	88	64
3	Zn ²⁺	Acetate	70	39	85	50
4	Fe ²⁺	Nitrate	66	19	87	30
5	Mn ²⁺	Acetate	62	64	83	76
6	UO ₂ ²⁺	Nitrate	70	50	-	-
7	Co ²⁺	Acetate	-	-	82LT	46
8	Pb ²⁺	Nitrate	65	70	76	66
9	Mg ²⁺	Acetate	66	60	-	-
10	V ⁵⁺	Sod.Salt	10	44	14	45
11	Hg ²⁺	Nitrate	60	05	90	97
12	As ³⁺	Oxide	58	58	65	22
13	Th ⁴⁺	Nitrate	-	-	40	15

Solvent system^I: Isoamyl Alcohol-H₂O-AcOH (20:10:10)

Solvent system^{II}: MeOH-Benzene-AcOH (20:10:15)

Imp* : 2.2' dipyridyl, Imp**: Imino diacetic acid

hR_f : Average of two or more identical runs in 10 cm. development.

solution of 2,2' dipyridyl or 0.75% aq. solution of iminodiacetic acid in the ratio 1:2. The plates were then activated at $60 \pm 1^\circ\text{C}$ for 24 h. Aq. solutions of metal salts were used for spotting. After development in the solvent system at a temperature of $31 \pm 1^\circ\text{C}$, the chromatograms were sprayed first with alcoholic alizarin (1%) and then with dithizone (0.5%) in carbon tetra chloride.

RESULT AND DISCUSSION

The hR_f values of metal ions on plain and impregnated silica gel plates are shown in table I. A difference of ± 4 units was considered as satisfactory resolution. Since it was not possible to separate all the metal ions in a single run, they were divided in to two following groups.

2,2' Dipyridyl impregnation

	Metal ion: Mn ²⁺	Fe ²⁺	Cu ²⁺	Zn ²⁺	Mg ²⁺			
<u>Metal Ions in Vivo</u>	hR_f : 64	19	44	39	60			
	Metal ion: Pb ²⁺	As ³⁺	Cd ²⁺	V ⁵⁺	Zn ²⁺	Hg ²⁺	UO ₂ ²⁺	
<u>Toxic Metal Ions</u>	hR_f : 70	58	63	44	39	05	50	

Iminodiacetic Acid impregnation

	Metal ion: Mn ²⁺	Fe ²⁺	Cu ²⁺	Zn ²⁺	Co ²⁺			
<u>Metal Ions in Vivo</u>	hR_f : 76	30	64	50	46			
	Metal ion: Pb ²⁺	Th ⁴⁺	As ³⁺	Cd ²⁺	V ⁵⁺	Zn ²⁺	Hg ²⁺	
<u>Toxic Metal Ions</u>	hR_f : 66	15	22	57	45	50	97	

Thus by selection of the impregnant it is possible to separate the metal ions in the groups of interest. The results reveal that for most of the metal ions the hR_f value on impregnated layer is less than on plain silica gel layer, indicating the less adsorption and less solubility of the interaction product of the metal ion with the ligand in the solvent system employed.

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