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Spectrophotometric Determination Of Fe, Co, Ni, Cu, Zn, Cd, Hg With 1-Methyl, 2-Acetyl Benzimidazole Thiosemicarbazone

K.Syamasundar
Department of Chemistry,
JNTU College of Engineering,
Kukatpally, Hyderabad- 500072 (INDIA)

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M.Adharvana Chari, D.Shobha
Department of Chemistry,
JNTU College of Engineering,
Kukatpally, Hyderabad- 500072 (INDIA)
E-mail: drmacj@yahoo.co.uk

ABSTRACT

A simple, sensitive and selective method for the spectrophotometric determination of Fe, Co, Ni, Cu, Zn, Cd and Hg in trace amounts by using 1-methyl-2-acetyl benzimidazole thiosemicarbazone as complexing agent. The coloured complex is stable and metal ligand ratios are observed as 1:2. The molar absorptivity, Beer's law applicability, stability constants and effect of diverse ions are studied.   © 2006 Trade Science Inc. - INDIA

INTRODUCTION

Various thiosemicarbazones have been reported in literature[1-3] for the spectrophotometric determination of divalent d-block metals. Thiosemicarbazones are important sulfur containing organic ligands. The metal chelates of these ligands find wide range of applications in medicine[4-6]. The use of thiosemicarbazones in inorganic analytical work has been reviewed by singh et al[7]. The ability of thiosemicarbazones in forming intense coloured complexes with various metal ions. But here the authors introduced a new reagent 1-methyl-2-acetyl benzimidazole thiosemicarbazone (MACBZTSC), which is a new re-agent for the spectrophotometric determination of divalent metal ions. 1-methyl-2-acetyl benzimidazole thiosemicarbazone is used as a chromophoric reagent for the extraction and spectrophotometric determination of divalent metals like Fe, Co, Ni, Cu, Zn, Cd and Hg.

RESULTS AND DISCUSSION

The absorption spectra of the MACBZTSC and its metal complexes were recorded in the wavelength range 300 to 500 nm individually against buffer and reagent blank respectively[8]. The reagent showed the negligible absorbance when compared to metal com-

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TABLE 1

Metal	Reagent	λ_{max} (nm)	Molar absorptivity Lit mol^{-1} cm^{-1}	Applicability of Beer's law	PH	Colour	Colour stability	Complex Composition	Interfering ions
–	MACBZTSC	340	–	–	–	Colourless	Colourless	–	–
Fe	–do–	377	3.523 x 10^3	1.0-5.8	9.5	Reddish Brown	72	1:2	Ag^I, Ce^{iv}, Cd^{II}, Co^{II},Cu^{II}, EDTA, Pb^{II}, Zn^{II}
Co	–do–	380	5.3 x 10^3	0.5 – 6.0	9.5	Purple Brown	72	1:2	Ag^I, Cd^{II}, Cu^{II}, V^v
Ni	–do–	372	3.67 x 10^3	0.5 - 5.2	9.5	Light Pink	36	1:2	Ag^I,Co^{II},Cd^{II}, Cu^{II}, Pb^{II},V^v, DMG, EDTA
Cu	–do–	385	6.67 x 10^3	0.4 – 5.6	9.5	Light Green	72	1:2	Ag^I,Cd^{+2},V^v, DMG, EDTA
Zn	–do–	375	5.24 x 10^3	0.6 - 5.2	9.5	Yellow	48	1:2	Ag^I,Co^{II},Cu^{II},V^v, DMG, EDTA
Cd	–do–	385	7.7 x 10^3	0.5 – 7.0	9.5	Dark Yellow	48	1:2	Ag^I,V^v, DMG, EDTA
Hg	–do–	378	4.08 x 10^3	0.5-14.8	9.5	Dark Yellow	60	1:2	Ag^1, Cu^{II}, Co^{II}, V^5, DMG, EDTA

plexes. The metal complexes were showed absorbance in the range 370-385 nm. The absorbance of the metal complexes is remains constant in the pH range 8.0 to 9.5. The studies are carried out at pH 9.0 using ammonical buffer.

The complexes colour is stable for 2-3 days. 10-15 fold molar excess of the reagent is used to obtain maximum colour intensity. Jobs and Mole ratio methods are applied for the determination of composition of the complexes. All the metals are formed complexes with MACBZTSC in 1: 2 ratio. Applicability of Beer's law, λ_{max}, Molar absorptivity, pH, colour of the complex, stability of the colour, composition of the complexes and interfering ions of the metal complexes data are presented in the TABLE 1. The amount of Iron is 5.586 μg/ml, Cobalt is 5.893 μg /ml, Nickel is 5.87 μg/ml, Copper is 6.35 μg/ml, Zinc is 6.538 μg/ml, Cadmium is 11.24 μg/ml and Mercury is 20.06 μg/ml is used in the determination.

Effect of interfereing ions[9]

The effect of various cations like Ag (I), Al (III), Ba(III), Ca(II), Cr(III), Cu(I), Cd(II), Fe(III), Hg(II), K(I), Mg(II), Mn(II), Mo(VI), Na(I),Ni(II), Pb(II), V(V) and Zn(II) are studied in the determination of different metal ions. Similarly the effect of different anions like bromide, carbonate, chloride, citrate, DMG, EDTA, fluoride, iodide, nitrite, nitrate, oxalate, phosphate, sulphite, sulphate, thiourea and thiocyanate are also studied. The interfering radicals are presented in the TABLE 1.

EXPERIMENTAL

All the chemicals used were of Anala R grade. The absorbance measurements were made using uv visible recording spectrophometer Model-U 3210, Hitachi Corporation, Tokyo, Japan. The pH measurements were made by using digital pH meter Model DPH 500.

Metal solutions were prepared by using known producere[10]. Buffer solutions were prepared by adopting the standard producers[11]. MACBZTSC is prepared by the method reported earlier[12]. To find out the metal ratios job's method of continuous variation and molar ratio methods are used.

The metal solutions are prepared by using double

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distilled water. The ligand solution is prepared by using pure methanol.

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