

Short Communication

Cycloalkyl aryl amino acids in spectrophotometric determination of copper

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Abstract

Two new reagents, namely 1-p-toluidino cyclohexane-1-carboxylic acid and 1-p-chloroanilino-cyclopentane-1-carboxylic acid have been used as spectrophotometric reagents for the determination of Cu(II). With both the reagents, Cu(II) forms 1:2 complexes. Values of $\log \beta$ were found to be 8.81 and 9.41 and the free energy of formation as -50.63 and -54.06 K Joules/mole, respectively.

Key words: Cycloalkyl aryl amino acids, copper determination, spectrophotometry.

1. Introduction

Though organic reagents¹⁻¹⁰ of different series are used for the spectrophotometric determination of Cu(II), cyclo-alkyl aryl amino acids have not been so far used as analytical reagents. In the present communication, the use of two reagents of this series, namely, 1-p-toluidino cyclohexane-1-carboxylic acid and 1-p-chloroanilino cyclopentane-1-carboxylic acid is reported.

2. Experimental

Preparation of reagents: Following Saharia *et al*¹¹, 1-p-toluidino cyclohexane-1-carboxylic acid (colourless small cubes m.p. 178°C; molecular formula C₁₄H₁₀O₂N; Elemental Analysis: C% found - 71.89; calc. 72.07; H% found 8.18, calc. 8.21; N% found-5.97, calc. 6.00) and 1-p-chloroanilino cyclopentane-1-carboxylic acid (colourless needles m.p. 168°C; molecular formula C₁₂H₁₄O₂NCl; C% found - 60.10, calc. 60.13; H% found - 5.85, calc. 5.89; N% found - 5.80, calc. 5.85; Cl% found 14.81, calc. 14.79) were obtained.

Solutions of these reagents $5 \times 10^{-3} \text{M}$ were prepared by dissolving the requisite amount in ethanol. An aqueous solution of Cu(II) $5 \times 10^{-3} \text{M}$ was prepared and standardized in usual manner. Absorbance measurements were made on EC spectrophotometer GS 866C using 1 cm-matched quartz cells. The pH measurements were made on Systronic pH-meter 324.

3. Results and discussion

Absorption spectra with Cu(II): Reagent ratio 1:5 revealed that there was no absorption maximum in each case. The working wave lengths chosen (Table I) are such that ethanol could be used as reference.

The colour development (yellowish green) was instantaneous and remained stable for two days. Constant maximum absorbance developed between pH 4.0 - 4.8 and metal: reagent ratio 1:5 and above in both the cases. The experiments were performed at 27°C.

Composition of the Cu(II) complex with both the reagents was determined using Job's¹², slope ratio¹³, and mole ratio¹⁴ methods and in both the cases was found to be Cu:R::1:2.

Beer's law is valid in the Cu(II) concentration range $5 \times 10^{-5} \text{M}$ to $4 \times 10^{-4} \text{M}$. Molar absorptivity and Sandell's sensitivity values were found (Table I). In both the cases the standard deviation ' σ ' was obtained by measuring the absorbance of ten solutions each containing 15.88 ppm of Cu(II) (Table I).

The stability constant in each case was determined using the method of Harvey and Manning^{13,15} (Table I). From these values free energy of formation was calculated using the relationship:

$$\Delta F = - 2.303 RT \ln \beta.$$

A comparison of the sensitivities reveal that both the reagents, 1-p-toluidino-cyclohexane 1-carboxylic acid and 1-p-chloroanilino cyclopentane-1-carboxylic acid, are more sensitive than tetraphenyl phosphonium chloride², calcichrome⁴, 6-methyl picoline amide oxime⁵, and N-methyl thioformyl-N-phenyl hydroxyl amine⁹.

Table I

Sl. No.	Reagents	Working wave length (in nm)	ϵ	Sandell's sensitivity in $\mu \text{g/cm}^2$	Standard deviation ' σ ' in ppm	$\log \beta$	ΔF in KJ/mole
1)	1-p-toluidino cyclohexane-1-carboxylic acid	410	1.05×10^3	0.0605	0.18	8.81	-50.63
2)	1-p-chloroanilino cyclopentane-1-carboxylic acid	390	1.02×10^3	0.0623	0.19	9.41	-54.06

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