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Uranyl complexes of Schiff bases: Preparation, characterization and biological activity

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Abstract

Uranyl complexes of Schiff bases derived from pyridine-2-carboxaldehyde and pyrazine-2-carboxylic hydrazone are reported and characterized based on elemental analyses, IR, solid reflectance, magnetic moment, molar conductance, and thermal analysis. The complexes are found to have the formula $[(UO_2) LX_2] \cdot 3H_2O$ where $X = CH_3OO^-$ or NO_3^- . The molar conductance data reveal that the metal chelates are non-electrolytic in nature. IR spectra shows that the ligand behaves in a bidentate manner utilizing azomethene nitrogen and carboxyl oxygen. From the magnetic and solid reflectance spectra, it is found that the geometrical structures of these complexes are octahedral and tetrahedral. The thermal behavior of these complexes shows that the hydrated complexes lose water molecule of hydration in the first step and is immediately followed by decomposition of the anions and ligand molecules in the subsequent steps. Ligands, in comparison to their metal complexes, were also screened for their antibacterial activity against bacterial species, *E. coli*, *Pseudomonas aeruginosa*, and *Staphylococcus Pyogones*, as well as fungi (*Candida*). The activity data show the metal complexes to be more potent antibacterial than the parent Schiff base.

Keywords: Uranyl complexes, Schiff base biological activity

Introduction

A large number of Schiff bases and their complexes have been studied for their interesting and important Properties ^[1-5], but relatively less attraction has been given to complexes with Schiff bases having heterocyclic substituents ^[6]. Consequently in the present paper a series of Uranyl complexes with a Schiff bases having pyridyl and pyrazinyl substituent.

Experimental

All chemicals used were of analytical reagent grade (AR) and of the highest purity available. Pyridine-2-aldehyde, Pyrazine-2-Carboxylic acid hydrazine hydrochloride and Uranyl salts were obtained from Aldrich.

Synthesis of Schiff base (L)

A hot solution (60 °C) of Pyridine-2-Aldehyde (2.1, 20 mmol) in 25 mL of ethanol was mixed with a hot solution (60 °C) of pyrazine-2-carboxylic hydrazone (2.88, 20 mmol) in the same solvent and the reaction mixture was left under reflux for 2 h. The solid product formed was separated by filtration, purified by crystallization from ethanol, washed with ether, and then dried in a vacuum over anhydrous calcium chloride. The green Schiff base product L is produced in 80% yields.

Synthesis of Uranyl Complexes

The metal complexes of the Schiff bases, L were prepared by the addition of a hot solution (60 °C) of the appropriate Uranyl salt (1 mmol) in an ethanol-water mixture (1:1, 25 mL) to the hot solution (60 °C) of the Schiff bases (2.43g, 1 mmol) in the same solvent (25mL). The resulting mixture was stirred under reflux for 1 h whereupon the complexes precipitated. They were collected by filtration, washed with a 1:1 ethanol-water mixture and diethyl ether. The analytical data for C, H, and N metal anion were repeated twice and were found to be in good agreement with proposed formula within 1% of error.

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Result and Discussion

The IR spectra of the complexes are compared with those of the free ligand in order to determine the coordination sites that may be involved in chelation.

The $\nu_{C=N}$ stretching vibration was shifted to lower wave

numbers indicating involvement in coordination. The $\nu_{C=O}$ also suffered a shift and indicates its involvement. New bands in the spectra of the complexes in the far IR region were assigned to ν_{M-N} and ν_{M-O} .

Table 1: Infrared absorption frequency of Uranyl complex

| Compound, ligand PAPCH | $\nu_{(C=N)}$ Azomethene | $\nu_{(C-N)}$ Hydrazinic | $\nu_{(C=O)}$ | | | |
|---|-----------------------------|-----------------------------|---------------|--------|--------|-----------------------------|
| | | | I | II | III | ν_{M-N} and ν_{M-O} |
| Ligand L | 1620 s | 1605 s | 1702 s | 1560 m | 1355 m | -- |
| [UO ₂ LCl ₂]3 H ₂ O | 1590 s | 1625 s | 1645 s | 1535 m | 1335 m | 450 m 390 w |
| [UO ₂ L(NO ₃)] H ₂ O | 1599 s | 1635 s | 1640 s | 1537 s | 1332 s | 462 m 385 w |
| [UO ₂ L(CH ₃ OO) ₂] 3H ₂ O | 1595 s | 1628 s | 1645 s | 1530 m | 1330 m | 455 m 385 w |

On the basis of above discussion structure of the complexes is shown in Fig-1 is proposed.

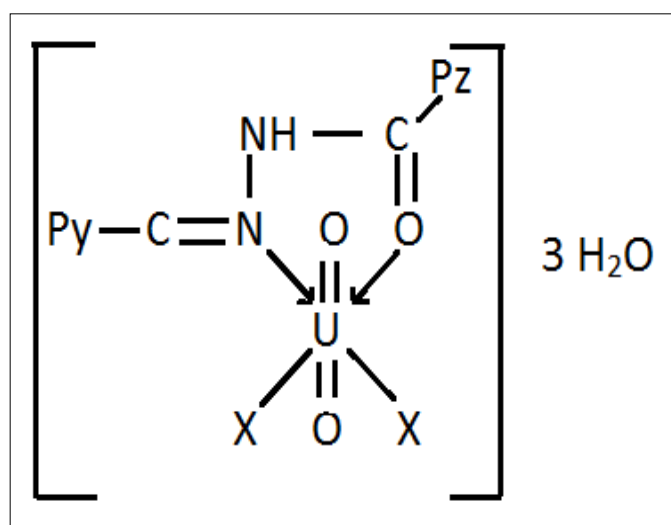


Fig 1: Above discussion structure of the complexes

Biological studies indicated complexes to be more active than the ligand.

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