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A simple Spectrophotometric investigation of Ceftriaxone Sodium and Esomeprazole complexes

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Abstract

A spectrophotometric study on a series of metal complex was carried out in which metal complexes were synthesized by using divalent metal ions such as Zn(II), Co(II), Cu(II) and Ni(II) with two medicinal drugs Ceftriaxone Sodium and Esomeprazole. The metal complexes were analyzed for magnetic measurements and spectrophotometric studies. The ligands and resulting metal complexes gave intense peak after irradiation of ultraviolet light. The electronic spectral data suggest the tetrahedral and square planar geometries of the complexes.

Keywords: Ceftriaxone Sodium, Esomeprazole, Metal Complexes, Electronic spectra, Magnetic measurement.

Introduction

Ceftriaxone Sodium (L_1) is a third generation long acting, broad-spectrum cephalosporin antibiotic drug. It is active against gram negative and gram positive microorganism[1,2] and is used in the treatment of neonates[3].

Ceftriaxone Sodium has three binding atoms N, O and S. The sulphur atoms present in a ring are sterically hindered hence cannot form a complex. Eight nitrogen atoms are present, out of which five are present in ring structure; one is tertiary amine, (=$\ddot{N}$-), another is secondary amine (>NH). The free amine (-NH_2) is most likely to form co-ordinate bond with metal ions. There are three types of oxygen atoms, NaO^- attached to ring, ketonyl oxygen and carboxylic oxygen. Out of these three types of donor oxygen atoms, carboxylate donor is expecting to bind with metals to form complex ions.

Metal complexes of ceftriaxone are possessing both toxicological and pharmacological properties. In general, depending upon the purity, antibacterial properties of ceftriaxone complexes can be increased or decreased, hence synthesis of such metal-antibiotic complexes is an important area of medicinal chemistry[4-6].

Esomeprazole(L_2) is a S-enantiomer of omeprazole. Omeprazole is a recemic mixture and has been a best selling drug from 1999 to 2001 in the market. Esomeprazole is having a good pharmacokinetic profile and having a better acid control than omeprazole. Esomeprazole has free functional group present in its structure. It contains a chiral sulfoxide center which bears the two large groups benzimidazolyl and pyridinylmethyl. Catalytic asymmetric oxidation of the corresponding sulfide is the most attractive approach to esomeprazole[7-13].

Material and Methods

General procedure for the synthesis of metal complexes: The solid complexes were synthesized by mixing the aqueous solution of metal salts [$CoCl_2$, $(CuNO_3)_2$, $(NiNO_3)_2$, $ZnCl_2$] with ethanolic solution of ceftriaxone sodium and esomeprazole in 1:1 molar ratio. The pH of solution maintains to basic with help of aqueous solution of NH_4OH. The resulting mixture was refluxed for 4-5 hours to obtain colored precipitate. The obtained mixture was cold at room temperature and then solid complex was filtered and washed twice with distilled water and dried.

Spectrophotometric study of metal complexes: For the study of metal-complexes, UV-Visible double beam spectrophotometer (Model: SL210) was used. In the present study, Pyrex glass cuvettes having 1.00 cm path length were used. The spectral range was selected from 280 to 1100 nm. A stock solution of complexes were prepared by taking 0.01gm of compound in 50ml of standard flask, dissolved in 2.5ml of DMSO and diluted up to the mark with distilled water. Reference solution was also prepared by taking 2.5ml of DMSO in 50ml standard flask and diluted up to the mark with distilled water. Then UV of complexes were recorded using UV-visible spectrophotometer.

Results and Discussion

The UV-VIS spectra shows absorption band attributed to d-d electronic transitions; these transitions are assigned in the relevance to the structure of the ligand and its complexes. d-d transitions appeared in the visible region. These transitions are assigned in relevance to the structures of complexes [14-16].

The UV-VIS spectral data of the compounds in DMSO is shown in table 1. The spectra of complexes observed some absorption bands in 280-1100 nm showing the relatively weak, low energy bands which may be assigned to the d-d transitions. These data are in accordance with assuming the formation of M-N, M-O and M-Cl bands. Absorption bands are assigned the $\pi - \pi^*$ and ligand to metal charge transfer spectra at higher energy[17-20].

Zn ion has d^{10} configuration and electronic spectrum of Zn(II) complex with L_1 showing d-d transition at 975 nm whereas in L_2 we observed two bands at 301 nm showing ligand to metal charge transfer spectra and 972 nm showing the d-d transition.

Table 1
Spectral data of L_1 and L_2 with its metal complexes

Compound	Electronic Absorption peak (nm)	Absorbance	Assignment
(L_1)	975	0.2611	d-d transition
Zn(L_1)	975	0.2464	d-d transition
Co(L_1)	973	0.2619	d-d transition
Cu(L_1)	975	0.2599	d-d transition
Ni(L_1)	976	0.2619	d-d transition
(L_2)	908	0.1026	d-d transition
	1090	0.1121	d-d transition
Zn(L_2)	301	0.3985	Charge transfer
	972	0.2450	d-d transition
Co((L_2)	300	0.4053	$\pi - \pi^*$
	971	0.2789	d-d transition
Cu(L_2)	973	0.3501	d-d transition
Ni(L_2)	299	0.6942	$\pi - \pi^*$
	975	0.2613	d-d transition

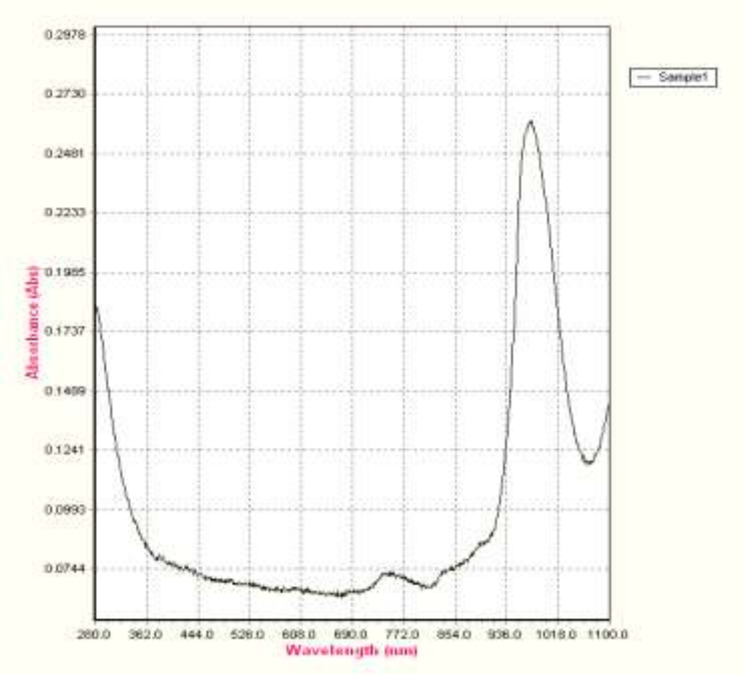

Fig. 1: Spectra of Ni-Ceftri Complex

The magnetic moment value was measured (μ_{eff} = 0) and the complexes of L_1 and L_2 are diamagnetic, most probably tetrahedral geometry for the complexes[21-24]. Co(II) complex shows one absorption band at 973 nm in L_1. The magnetic moment value (μ_{eff} =0.3438) and two bands in L_2 at 300 nm and 971 nm are assigning $\pi - \pi^*$ transition and d-d transition respectively. These transitions are measured the magnetic moment value (μ_{eff} =0.3438) and the complexes of L_1 and L_2 are paramagnetic Suggesting tetrahedral geometry for the complexes.

The electronic spectrum of Cu(II) complexes exhibited bands at 975 nm and 973 nm for L_1 and L_2 respectively. These transitions measured the magnetic moment value (μ_{eff} =0.0861) and the complexes of L_1 and L_2 are paramagnetic and a square planar geometry may be assumed for the Cu(II) complexes[25, 26].

Ni(II) complexes show bands at 976 nm for L_1 assigning d-d transition and 299 nm and 975 nm showing $\pi - \pi^*$ and d-d transitions respectively for the ligand L_2. The magnetic moment values were measured (μ_{eff} =0.3371) and the complexes of L_1 and L_2 are paramagnetic, a square planar geometry may be expected for the Ni(II) complexes[27].

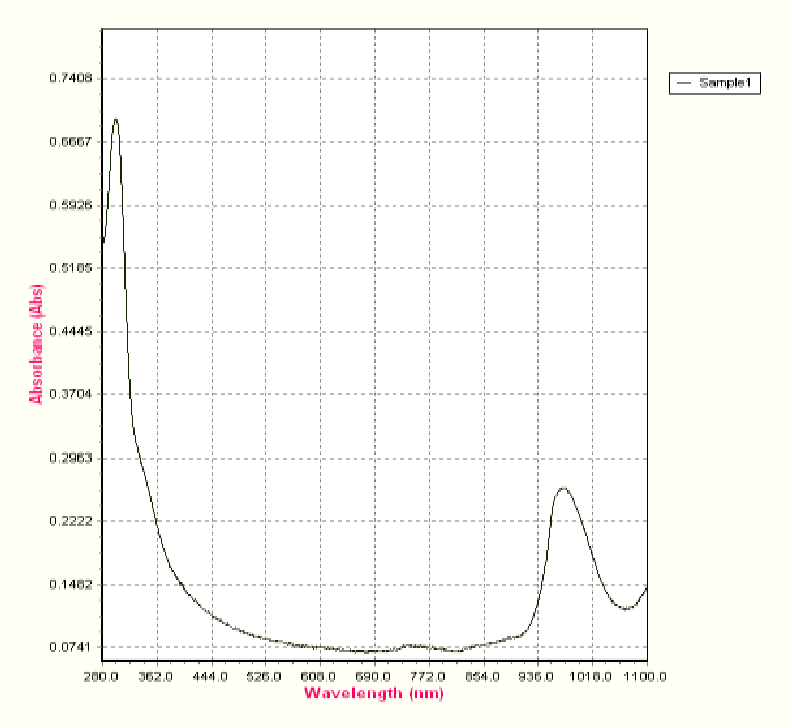

Fig. 2: Spectra of Ni-Esom Complex

Conclusion

The described spectroscopic method was found to be simple and very sensitive, hence it was used to determine medicinal drugs and their metal complexes. Ligand L_1 shows d-d transition at low energy bands for Zn(II), Co(II), Cu(II) and Ni(II) metals. Ligand L_2 shows d-d transition whereas Zn(II) shows charge transfer and d-d transition. Co(II) and Ni(II) show $\pi - \pi^*$ and d-d transition and Cu(II) shows d-d transition.

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