

Physico-Chemical Study of Mixed Ligand Complexes

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Abstract

Reaction of Ampicillin and Alanine with certain biologically active metal ions, in binary and ternary systems have been traced conductometrically and spectrophotometrically. Formation of M:Ala:Amp. 1:1 and 1:2 complexes and M:Ala:Amp 1:1:1 complexes with metal:Alanine:Ampicillin in 1:1:1 molar ratio have been ascertained on the basis of analytical data and physiochemical properties. The results of metal bridged drug receptor complex is formed during antibiotic activity of drug.

Key words : Mixed ligand complexes, bridged drug receptor, antibiotic activity.

Introduction

Coordination complexes play vital role in biochemical reactions. Recently probability of the formation of metal bridged drug-receptor complex has been proposed during biological activity of drugs. As ampicillin function by attacking the peptide bond at D-alanine and D-alanine (alanine) of the cell membrane of bacteria hence, in this communication interaction of certain metal ions with Alanine and Ampicillin molecules has been worked out with special reference to formation of mixed complexes. The metal ions used were, the common biologically important ions found to activate the various enzyme systems, viz, Cu(II), Co(II), Mn(II), Mg(II), Zn(II) and Fe(II).

Experimental

All the chemicals used were high purity A.R or S. M grade. Samples of Ampicillin were obtained from Gufic Pharm. Lab. Gujrat.

Nair and Pandey's Monovariation method has been used to determine stoichiometry of the species formed in binary and ternary systems. While the change in value of λ_{max} for the binary and ternary systems has been used to ascertain the formation of new species. The site of linking of two ligands with metal ions in the mixed complexes (1:1:1, metal:Ala:Amp) isolated by mixing the aqueous solutions of the metal ions and the ligands in the stoichiometric ratio was ascertained with the help of I.R. spectra.

Result

Conductometric studies indicate that Cu(II), Mn(II), Co(II), Mg(II), Zn(II) and Fe(II) forms 1:1 and 1:2 complexes with Ampicillin and Alanine formation of mixed ligand complex is clearly indicated when Metal :Alanine 1:1 complex is reacted with Ampicillin molecule⁵⁻⁹.

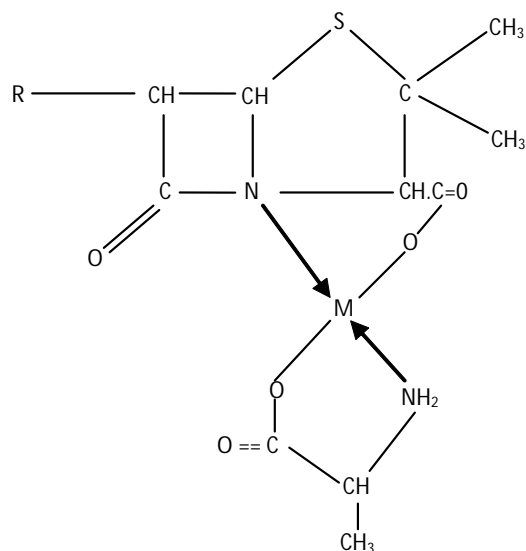
The spectrophotometric results also confirm formation of mixed ligand complexes with these ligands and metal ions used in study of lambda max is obtained when metal Alanine complex 1:1 is reacted with Ampicillin to get metal:Alanine:Ampicillin in 1:1:1 molar ratio. The analytical data also confirms the formation of mixed metal complexes⁵⁻⁷.

Table 1. Physical Properties of Metal Complexes

Metal	Complex with Ampicillin-6		Complex with Ampicillin Alanine	
	Colour	m.p. °C	Colour	m.p. °C
Cu(II)	Blackish brown	170	Bottle green	158
Mg(II)	Whitish	165	Pale white	244
Mn(II)	Buff	169	Pale yellow	240
Fe(II)	Brown	205	Yellow dark	about 350
Co(II)	-	-	Brown pale	228
Zn(II)	Brownish Yellow	180	Pale yellow	225

Table 2. I.R. Frequencies of Mixed Ligand Complexes

Ligand metal complexes	N-H		Sec. amide Bend	β -lectam thiazolidine	OCO	
	Stret	Def			Sym	Asym
Na-Am.	3360	-	1512	1770	1398	1614
Alanine	3050	1580	-	-	-	1610
Mg(II)	3220	1390	1510	1745	1370	1630
Mn(II)	3240	1385	1510	1745	1370	1625
Fe(II)	3250	1590	1520	1750	1370	1640
Co(II)	3250	1590	1510	1750	1370	1630
Zn(II)	3210	1585	1510	1745	1370	1640
Cu(II)	3250	1590	1510	1750	1370	1640



(M=Mg, Mn, Fe Co, Zn & Cu)

Where R-[NHCOCH(NH₂)C₆H₅ for mixed ampicillin complex]

These mixed complexes differ appreciably in their colour from corresponding metal-Alanine or the metal Ampicillin complexes. Both Ampicillin and Alanine molecules have been shown to function as bidentate ligands. While Ampicillin molecule chellates with the metal ions using its ternary N adn COO group of the beta-lactum thiozolidine ring, alanine traps the metal ion through its- NH₂ and deprotonated -COOH group. Thus the beta-lactum amide band in the drug appearing at 1770 cm inverse is shifted to 1750 cm inverse in the complexes while the asym and sym COO frequency appearing at 1614 and 1398 cm inverse shift to ~1640 and ~1370 cm inverse resp. Similarly the bands at 3050 and 1610 and 1580 cm inverse for the protonated amino group in Alanine have benn shifted to 3250, 1630 and 1590 cm inverse resp in the complexes¹⁰⁻¹¹.

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