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Synthesis, Spectral and Microbial studies of Mixed Ligand Zn(II) Complexes

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ABSTRACT:-

New series of mixed ligand Zn(II) complexes were prepared using 8-hydroxyquinoline (HQ) as a primary ligand & N-and/or O-donor amino acids (HL) as secondary ligandThe metal complexes were characterizes on the basis ofelemental analysis, electrical conductance, magnetic susceptibility measurementsand spectral studies such as UV-Visible spectra,FTIR spectra and XRD. Tube dilution and Agar cup methods were implemented for study the antibacterial activity of the complexes against the pathogenic bacteria Staphylococcus aureus, Corynebacterium diphtheriae, Salmonella typhi and Escherichia coli. The results have been compared with those of tetracycline, which was screened simultaneously & indicated mild antibacterial activity of the complexes.

KEYWORDS: - Zinc, Mixed ligand complexes, antimicrobial activities,amino acids.

1. INTRODUCTION:-

Mixed ligand complexes of transition metal ions have great interesting from the researchers who study their coordination behaviour and exploiting their properties in a different fields especially the antibacterial activity (1-3), 8-hydroxy quinolone is an important compound which has the ability to coordinate with a various ions as bidentate through nitrogen atom of quinolone ring and oxygen atom after deprotonation of hydroxyl group (4-7) to format five member ring between this ligand with the central metal ion that helps to increase the stability of the complexes, as well as its known biological activity(8,9,10). Amino acids are well known for their tendency to form complexes with metals having biological significance & metabolic enzymatic activities (11,12). Mixed ligand complexes has also been reported to show Anti-tumour activities (13, 14). The antibacterial & Anti-fungal properties of a range of Zinc (II) complexes have been evaluated against several pathogenic bacteria & fungi (15-16).

Many researchers have studied characterization, antimicrobial and toxicological activity of mixed ligand complexesof transition metals and actinide metal ion (17-22). Antitumour activity of some mixed ligand complexes have also reported (23, 24) therefore it was decided to study the complexation,characterization and biological activities of Zn complexes.The present paper reports synthesis, characterization & antibacterial studies of the mixed ligand Zn (II) complexes prepared with 8-hydroxyqunoline (HQ) as a primary ligand & amino acids (HL) such as L-valine, L-asparagine, L-glutamine, L-arginine and L-methionine as a secondary ligands. The metal complexes have been characterized on the basis of elemental analysis & various physico-chemical techniques such as molar conductance, magnetic susceptibility, electronic spectra, IR spectra & thermal studies.

2. MATERIALS AND METHODS:-

2.1 Materials

Analytical grade Zinc (II) chloride dehydrate was used as such without further purification L-valine, L-asparagine, L-glutamine, L-arginine and L-methionine & 8-hydroxyqunoline were obtained from

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S.D. Fine chemicals, Mumbai, India. Solvents like ethanol, dimethyl sulphoxied& laboratory grade chemicals, whenever used were distilled & purified according to standard procedures (25,26,27).

2.2 Instrumentation

The C, H, N & S elemental analysis of Zn (II) complexes were carried out on thermo Finnigan elemental Analyser, Model No. FLASH EA 1112 Series at Department Of Chemistry, I.I.T., Mumbai. Metal content was estimated complexometrically by standard procedure (28,29).

The complexes were dissolve in DMSO (10 M) to measure Molar Conductance values on an Equiptronics Auto Ranging Conductivity Meter Model No. EQ -667 with a dip type conductivity cell fitted with -1platinum electrodes (cell constant= 1.0 cm).

The room temperature magnetic susceptibility measurements of the complexes reported in the present study were made by the Guoy's method using Hg [Co(SCN)] as calibrant at Department of Chemistry, 4 I.I.T., Mumbai. The electronic absorption spectra of all the complexes in DMSO -3solution (10 M) in the ultraviolet & visible region were recorded on Shimadzu UV/VIS-160 spectrometer using quartz cell of 1cm optical path at GNIRD, Mumbai.Infrared spectra of all the ligands & there metal complexes were recorded in KBr discs on a Perkin-Elmer FTIR spectrophotometer -1model 1600 in the region 4000-400 cm at Department of Chemistry, I.I.T., Mumbai. The pellets were prepared taking necessary precautions to avoid moisture. The instrument calibration with respect to wave number and percent transmission was confirmed by recording the spectrum of standard polystyrene film. From the spectra, the characteristic groups were assigned the respected frequencies (30).

The Thermogravimetric (TG) & Differential Thermal Analysis (DTA) measurements were carried out in controlled nitrogen atmosphere on a Perkin-Elmer Diamond TG-DTA instrument at the Department of Chemistry, I.I.T., Mumbai By recording the change in weight of the Ocomplexes on increasing temperature up to 900^0 C at heating rate of 10^0 C per min.

2.3:- Preparation of Mixed Ligand Complexes

Mixed ligand zinc (II) complexes were synthesized from zinc (II) chloride dihydrate, 8-hydroxy-quinoline (HQ) as a primary ligand and different amino acids (HL) such as L-valine, L-asparagine,L-glutamine, L-arginine and L-methionine as secondary ligand.

An aqueous solution (10 cm) of zinc (II) chloride dihydrate (136.29 3mg, 1mmol) was mixed with ethanolic solution (10 cm) of 8hydroxyquinoline (145 mg, 1mmol). The mixture was stirred and kept in a boiling water bath for 10 minutes. To this hot solution, an aqueous 3solution (10 cm) of amino acid (1 mmol) was added with constant stirring. The reaction mixture (1:1:1 molar proportion) was taken in water bath and heated for about 10 minutes till the temperature reached 0to 50^0C.

The pH of the mixture was raised by adding dilute ammonia solution in the reaction mixture and complex was obtained. Then the mixture was cooled and solid complex obtained was filtered, washed with water followed by ethanol. The complexes thus synthesized were dried under vacuum.

2.4 Antibacterial screening

2.4.1 Agar Cup Method:-

Antibacterial screening of single compound against a number of organism or given organism against different concentrations of the same compound can be carried out by Agar Cup Method. Author studies reveals that this method is suitable for semisolid or liquid samples and was used in the present work.

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In Agar Cup Method, a plate of sterile nutrient agar with the desired test strain was poured to a height of about 5 mm, allowed to solidify and a single cup of 8 mm diameter was cut from the center of the plate with a sterile cork borer. Thereafter the cup was filled with the sample solution of 1000 $\mu g/cm^3$concentration. The test solution was allowed to diffuse in surrounding agar by keeping in refrigerator for 10 min and the plate was incubated at 370C for 24 hrs. The extent of inhibition of growth from the edge of the cup was considered as a measure of the activity of the given compound. By using several plates simultaneously, the activities of several samples could be qualitatively studied.

2.4.2 Tube Dilution Method:-

The test compounds were subjected to in vitro screening against Staphylococcus aureus, Corynebacterium diphtheriae, Salmonella typhi and Escherichia coli using Muller Hinton broth as the culture medium. The test compound (10 mg) was dissolved in DMSO (10 cm^3) so as to prepare a stock solution of concentration 1000 $\mu g/cm^3$. From this stock solution, aliquots of 50, 100, 150, 200 to ....., 1000 µg/cm3 was obtained in test broth.Bacterial inoculums were prepared in sterilized Muller Hinton broth and incubated for 24 hrs. at 37^0C. The aliquots were dispensed (5 cm3) in each borosilicate test tube (150 x 20 mm). The bacterial inoculums 0.1 cm3 of the desired bacterial strain (Staphylococcus aureus, Corynebacterium diphtheriae, Salmonella typhi and Escherichia coli) containing 106 bacteria/cm3 was inoculated in the tube. The tubes were incubated at 37^0C for 24 hrs. and then examined for the presence or absence of the growth of the test organisms.

The lowest concentration which showed no visible growth was noted as minimum inhibitory concentration (MIC).Tetracycline was used as standard drug against Gram-positive and Gram-negative bacteria by similar screening procedure. The solvent DMSO was also tested as control to see that it did not affect the growth of the culture. MIC of tetracycline was found to be 1.5 µg/cm3 against Staphylococcus aureus, 2.0 µg/cm3 against Corynebacterium diphtheriae, 1.5 µg/cm3 against Salmonella typhi and 2.5 µg/cm3 against Escherichia coli

3. RESULTS& DISCUSSION:-

3.1 Characterization of Metal Complexes

All the complexes in general are colored, non-hygroscopic, thermally stable solids (Table 1). The complexes are insoluble in water and in common organic solvents such as ethyl alcohol, acetone, chloroform, etc., but partially soluble in DMF and DMSO. This insolubility of complexes hampered the molecular weight determination. Therefore molecular weights were computed using analytical data. All mixed ligand zinc (II) complexes are yellow in colour. The elemental analysis data (Table 2) of metal complexes are consistent with their general formulation as 1:1:1 mixed ligand complexes of the type [Zn (Q)(L)].$2H_2O$. The molar conductance values of the complexes in DMSO at 10^{-3} M concentration are low (< 1) indicating their non-electrolytic nature(31).

3.2 Elemental Analysis and Conductivity measurement

The Analytical data and Physical properties of complexes are tabulated in table (1-4) . The analytical data are in good agreement with the proposed empirical formulae of the prepared Zn complexes. The molar conductance of 10^{-3} solution of complexes in DMSO were measured at 30^0C. The molar conductance values (table2) indicates that all complexes are non-electrolytic in DMSO and proved that anions are covalently bonded in all the cases.

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3.3 Magnetic moment

Magnetic moment datais summarized in table 2 . From magnetic susceptibility data it has been observed that molar magnetic susceptibility values are negative hence Zn(II) complexes which indicates diamagnetic character.

3.4 Electronic absorption spectra

The electronic spectra of metal complexes are recorded in 10-3 M DMSO at 30^0C in UV-Visible region. Spectral data is tabulated in Table 5. The Spectra of each complexes shows three transitions in the range 273-280 nm (36630- 35714cm^{-1}), 335-339 nm (29851-29499 cm^{-1}) and 390-398 nm, (25641-25126 cm^{-1})ascribed $\pi \rightarrow \pi^*$ $n \rightarrow \pi^*$ and the charge transfer transitions (LMCT) from the ligands to the metal, respectively (32) As the term implies, these transitions involve electron transfer from one part of the complex to another which are fully allowed and hence give rise to much more intense absorption.This is Characteristics of transition metal complexes.

3.5 Infra –red spectra

From IR frequencies of metal complexes results in Table 6, various absorption bands were seen on the spectra of ligands and complexes. Some of the bands (around 3300-3600cm-^{1}) present on ligands disappeared in complexes while some of the bands shifted to change their positions.The phenomenon indicates coordination of the metal to ligand (33-36).i.e. complex formation may occurred due to deprotonation of hydroxyl group of HQ moiety and formation of O-M bond.

A strong band observed in range 1111-1105 cm^{-1}indicates presence of oxygen moiety in complexes coordinated through its O/N atoms.A absorption band of free HQ at 1500cm^{-1} found to shifted to lower region at 1460 cm^{-1} indicates coordination through tertiary Nitrogen of 8-HQ.(10,33,37).In plane and out of plane vibrations at 505 cm^{-1} and 786-791 cm^{-1} indicates coordination through N of HQ to region of metal ion i.e. formation of N-M bond.A broad band in the region of 3282-3205 $cm^{-1}$and a weak band in the region of (1570-1575 cm^{-1}) occurs due to H-O-H bonding vibration which indicates presence of coordinated water (38,39,40).IR bands at 3058-3050 cm^{-1} and 3176-3086 cm^{-1} due to free amino acids are found to disappeared and shifted to high-frequencies. This indicates coordination is takes place between Nitrogen atoms of amino acid to metal ion. i.e., formation of M-N bond (A.A)Asymmetric (COO-) bond of free amino acid ranging at 1643-1632 cm^{-1} is shifted to higher frequency and symmetric(COO-) band ranging between 1373 to 1370cm-^{1} is shifted to lower frequency in the spectra of complexes,this confirmed coordination of carboxylic acid group via oxygen atom with metal ion i.e. formation of M-O bond.Some new weak band between 605-600 and 410 cm^{-1}may ascribed to formation of M-O and M-N bands respectively (38-42).It is noted that these bands absent in IR spectra of 8HQ and amino acids hence the M-O band has much less covalent character than M-N bond so stretching bands of former appears at lower frequency (43).

3.6 Thermal studies

The TG and DTA studies of the complexes have been recorded in the 0nitrogen atmosphere at the constant heating rate of 10^0C/ min. Thermal study on the mixed ligand Zinc complexes in controlled nitrogen atmosphere was carried out to understand stages and temperature range of decomposition. The most probable decomposition pattern of the complexes is proposed on the basis of the careful examination of TG and DTA curve. The thermal analytical data in Table 7.

The thermograms of these complexes show the loss in weight corresponding to two water molecules in the temperature range 131^0C -171^0C, followed by simultaneous weight loss in the range of 245^0C-560^0C which is algebraic sum of weight loss due to both amino acid and 8-hydroxyquinoline moieties.The DTA of the complexes display an endothermic peak in the range 131^0C -171^0C which

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indicate the presence of two co-ordinated water molecules. As the temperature is raised, the DTA curve shows a broad exotherm in the range 245-560 ^{0}C attributed to simultaneous decomposition of amino acid and 8-hydroxyquinoline moieties present in the complexes. The formation of a broad exotherm is possibly due to simultaneous decomposition of ligand moieties and their subsequent oxidation to gaseous products like CO, HO, etc. (44-48).

3.7XRD

Like most of the metal organic complexes, these complexes also decompose to a fine powder of metal oxide i.e. ZnO. The constant 0weight plateau in TG after 610C indicates completion of the reaction. The ZnO formed was confirmed by X-ray diffraction pattern of the decomposed product (49).

3.8 Biological studies

All the metal complexes were screened against Staphylococcus aureus, Corynebacterium diphtheria, Salmonella typhi and Escherium coli.

The studies based on agar cup method revealed that the complexes are most sensitive against Staphylococcus aureus and Salmonella typhi and less sensitive against Corynebacterium diphtheria and Escherium coli (Table 7).

The minimum inhibitory concentration (MIC) of complexes (Table 8) ranges between 50-200 µg/mL. The complexes are found to be more active against, Corynebacterium diphtheria, Salmonella typhi and Escherium coli and less sensitive against Staphylococcus aureus. As compared to standard antibacterial compound, tetracycline, the complexes show moderate activity against selected strains of microorganisms (50). The biological activity of this complexes is due to bulky structure of the complexes.

Table1. Empirical formula, molecular weight, colour of the Zinc complexes studied

No.	Complex	Empirical Formula	Molecular Weight	Colour
1	[Zn(Q)(Val)].2H_2O	$ZnC_{14}H_{20}O_5N_2$	361.72	Yellow
2	[Zn (Q)(Asp].2H_2O	$ZnC_{13}H_{13}O_6N_3$	376.69	Yellow
3	[Zn (Q)(Glu].2H_2O	$ZnC_{14}H_{19}O_6N_3$	390.72	Yellow
4	[Zn (Q)(Arg)].2H_2O	$ZnC_{15}H_{23}O_5N_5$	418.78	Yellow
5	[Zn (Q)(Met)].2H_2O	$ZnC_{14}H_{20}O_{20}N_5S_2$	393.79	Yellow

Q represents the deprotonated primary ligand-8-hydroxyquinoline, whereas Val,Asp,Glu,Arg. & Met. represent deprotonated secondary ligands: L-valine, L-asparagine, L-glutamine, L-arginine and L-methionine respectively.

Table 2.Decomposition Temperature & pH of the Zinc complexes studied

No.	Complex	Decomposition Temperature (^{0}C)	pH
1	[Zn(Q)(Val)].2H_2O	249	6.89
2	[Zn (Q)(Asp].2H_2O	248	6.98
3	[Zn (Q)(Glu].2H_2O	266	7.04
4	[Zn (Q)(Arg)].2H_2O	260	6.97
5	[Zn (Q)(Met)].2H_2O	262	7.00

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Table 3. Elemental analysis data of Zinc complexes.

No.	Complex	Elemental Analysis Found (Calculated)				
		% M	% C	% H	% N	% S
1	[Zn(Q)(Val)].2H_2O	18.07 (18.08)	46.47 (46.48)	05.56 (05.58)	07.74 (07.75)	----
2	[Zn (Q)(Asp].2H_2O	17.35 (17.36)	41.44 (41.45)	04.56 (04.56)	11.15 (11.16)	--
3	[Zn (Q)(Glu].2H_2O	16.74 (16.74)	43.02 (43.03)	04.89 (04.91)	10.75 (10.76)	--
4	[Zn (Q)(Arg)].2H_2O	15.60 (15.61)	43.01 (43.02)	05.53 (05.55)	16.73 (16.73)	--
5	[Zn (Q)(Met)].2H_2O	16.59 (16.61)	42.68 (42.70)	05.12 (05.13)	07.11 (07.12)	08.12 (08.14)

Abbreviation's see Table 1.

Table 4. Molar conductance, Magnetic moments of Zinc complexes.

No.	Complex	Xg	Xm	Molar conductance (Mhos cm^2 mol^{-1})	μ_{eff} (B.M.)
1	[Zn(Q)(Val)].2H_2O	-1.21 x 10^{-3}	-4.42 x 10^{-3}	0.028	Diamagnetic
2	[Zn (Q)(Asp].2H_2O	-4.82 x 10^{-3}	-1.72 x 10^{-3}	0.026	Diamagnetic
3	[Zn (Q)(Glu].2H_2O	-6.67 x 10^{-3}	-2.49 x 10^{-3}	0.019	Diamagnetic
4	[Zn (Q)(Arg)].2H_2O	-4.83 x 10^{-3}	-1.75 x 10^{-3}	0.025	Diamagnetic
5	[Zn (Q)(Met)].2H_2O	-1.61 x 10^{-3}	-5.72 x 10^{-3}	0.014	Diamagnetic

Abbreviation's see Table 1.

Table 5. Electronic Spectral Data of Zinc (II) Complexes

No.	Complex	λ (nm)	ν (cm- 1)	Proposed Assignments
1	[Zn(Q)(Val)].2H_2O	273	36630	$\pi \rightarrow \pi^*$
		335	29851	$n \rightarrow \pi^*$
		390	25641	Charge transfer
2	[Zn (Q)(Asp].2H_2O	278	35971	$\pi \rightarrow \pi^*$
		339	29499	$n \rightarrow \pi^*$
		395	25316	Charge transfer
3	[Zn (Q)(Glu].2H_2O	280	35714	$\pi \rightarrow \pi^*$
		338	29586	$n \rightarrow \pi^*$
		397	25189	Charge transfer
4	[Zn (Q)(Arg)].2H_2O	279	35842	$\pi \rightarrow \pi^*$
		338	29586	$n \rightarrow \pi^*$
		398	25126	Charge transfer
5	[Zn (Q)(Met)].2H_2O	274	36496	$\pi \rightarrow \pi^*$
		338	29586	$n \rightarrow \pi^*$
		396	25253	Charge transfer

Abbreviation's see Table 1.

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Table 6.Selected IR Spectral Data of mixed ligand Zn complexes

No.	Complex	(O-H) H_2O	(C=O) AA	(C-O) AA	(C=N) HQ	(C-O) HQ	Out plane HQ	In plane HQ	(M-O)	(M-N)
1	[Zn(Q)(Val)].$2H_2O$	3282(w)	3176(w)	3055(w)	1500(s)	1107(s)	791(s)	505(m)	600(w)	410(w)
2	[Zn (Q)(Asp].$2H_2O$	3209(w)	3174(w)	3057(w)	1500(s)	1107(s)	786(s)	505(m)	605(w)	410(w)
3	[Zn (Q)(Glu].$2H_2O$	3205(w)	3086(w)	3058(w)	1500(s)	1107(s)	791(s)	505(m)	605(w)	410(w)
4	[Zn (Q)(Arg)].$2H_2O$	3206(w)	3089(w)	3058(w)	1500(s)	1107(s)	790(s)	505(m)	605(w)	410(w)
5	[Zn (Q)(Met)].$2H_2O$	3205(w)	3086(w)	3057(w)	1500(s)	1107(s)	790(s)	504(m)	605(w)	410(w)

Table 7. Thermal data of Zinc complexes

No.	Complex	Temperature range for loss of water molecules	Weight loss due to water		Temperature range for loss of 8HQ & amino acid (C)	Weight loss due to 8HQ & amino acid	
			Found	Calculated		Found	Calculated
1	[Zn(Q)(Val)].$2H_2O$	135-171	10.02	09.96	248-552	72.00	71.96
2	[Zn (Q)(Asp].$2H_2O$	139-169	09.87	09.56	552-557	73.10	73.07
3	[Zn (Q)(Glu].$2H_2O$	140-165	09.35	09.22	546-560	74.20	74.04
4	[Zn (Q)(Arg)].$2H_2O$	131-165	08.75	08.60	249-558	75.80	75.78
5	[Zn (Q)(Met)].$2H_2O$	143-170	09.25	09.15	245-552	74.35	74.24

Abbreviation's see Table 1.

Table 8. Antibacterial activity (mm) of Zinc complex by Agar Cup Method

No.	Complex	Test			
		S.aureus	C.diphtheriae	S. typhi	E.coli
1	[Zn(Q)(Val)].$2H_2O$	25	14	20	13
2	[Zn (Q)(Asp].$2H_2O$	23	15	24	14
3	[Zn (Q)(Glu].$2H_2O$	26	18	24	12
4	[Zn (Q)(Arg)].$2H_2O$	24	16	23	12
5	[Zn (Q)(Met)].$2H_2O$	22	12	22	13
6	Tetracycline	30	25	26	26

Abbreviations see Table 1

Table 9.MIC(mg/ml)data of Zinc complexes.

No.	Complex	S.aureus	C.diphtheriae	S. typhi	E.coli
1	[Zn(Q)(Val)].$2H_2O$	50	200	100	50
2	[Zn (Q)(Asp].$2H_2O$	50	150	50	50
3	[Zn (Q)(Glu].$2H_2O$	50	150	50	100
4	[Zn (Q)(Arg)].$2H_2O$	50	150	100	150
5	[Zn (Q)(Met)].$2H_2O$	50	200	100	50

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3	[Zn (Q)(Glu].2H_2O	16.74 (16.74)	43.02 (43.03)	04.89 (04.91)	10.75 (10.76)	--
4	[Zn (Q)(Arg)].2H_2O	15.60 (15.61)	43.01 (43.02)	05.53 (05.55)	16.73 (16.73)	--
5	[Zn (Q)(Met)].2H_2O	16.59 (16.61)	42.68 (42.70)	05.12 (05.13)	07.11 (07.12)	08.12 (08.14)

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3	[Zn (Q)(Glu].2H_2O	-6.67 x 10^{-3}	-2.49 x 10^{-3}	0.019	Diamagnetic
4	[Zn (Q)(Arg)].2H_2O	-4.83 x 10^{-3}	-1.75 x 10^{-3}	0.025	Diamagnetic
5	[Zn (Q)(Met)].2H_2O	-1.61 x 10^{-3}	-5.72 x 10^{-3}	0.014	Diamagnetic

Abbreviation's see Table 1.

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		338	29586	$n \rightarrow \pi^*$
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2	[Zn (Q)(Asp].2H_2O	3209(w)	3174(w)	3057(w)	1500(s)	1107(s)	786(s)	505(m)	605(w)	410(w)
3	[Zn (Q)(Glu].2H_2O	3205(w)	3086(w)	3058(w)	1500(s)	1107(s)	791(s)	505(m)	605(w)	410(w)
4	[Zn (Q)(Arg)].2H_2O	3206(w)	3089(w)	3058(w)	1500(s)	1107(s)	790(s)	505(m)	605(w)	410(w)
5	[Zn (Q)(Met)].2H_2O	3205(w)	3086(w)	3057(w)	1500(s)	1107(s)	790(s)	504(m)	605(w)	410(w)

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No.	Complex	Temperature range for loss of water molecules	Weight loss due to water		Temperature range for loss of 8HQ & amino acid (C)	Weight loss due to 8HQ & amino acid	
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2	[Zn (Q)(Asp].2H_2O	139-169	09.87	09.56	552-557	73.10	73.07
3	[Zn (Q)(Glu].2H_2O	140-165	09.35	09.22	546-560	74.20	74.04
4	[Zn (Q)(Arg)].2H_2O	131-165	08.75	08.60	249-558	75.80	75.78
5	[Zn (Q)(Met)].2H_2O	143-170	09.25	09.15	245-552	74.35	74.24

Abbreviation's see Table 1.

Table 8. Antibacterial activity (mm) of Zinc complex by Agar Cup Method

No.	Complex	Test			
		S.aureus	C.diphtheriae	S. typhi	E.coli
1	[Zn(Q)(Val)].2H_2O	25	14	20	13
2	[Zn (Q)(Asp].2H_2O	23	15	24	14
3	[Zn (Q)(Glu].2H_2O	26	18	24	12
4	[Zn (Q)(Arg)].2H_2O	24	16	23	12
5	[Zn (Q)(Met)].2H_2O	22	12	22	13
6	Tetracycline	30	25	26	26

Abbreviations see Table 1

Table 9.MIC(mg/ml)data of Zinc complexes.

No.	Complex	S.aureus	C.diphtheriae	S. typhi	E.coli
1	[Zn(Q)(Val)].2H_2O	50	200	100	50
2	[Zn (Q)(Asp].2H_2O	50	150	50	50
3	[Zn (Q)(Glu].2H_2O	50	150	50	100
4	[Zn (Q)(Arg)].2H_2O	50	150	100	150
5	[Zn (Q)(Met)].2H_2O	50	200	100	50

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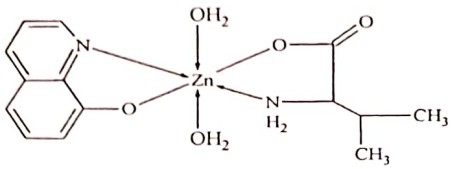
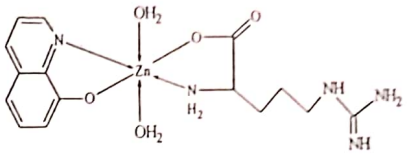
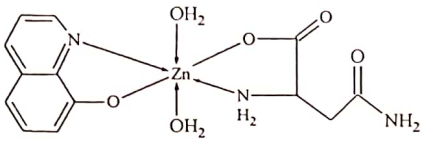
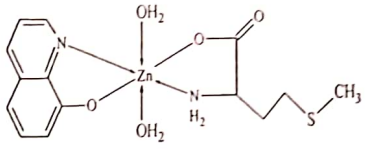
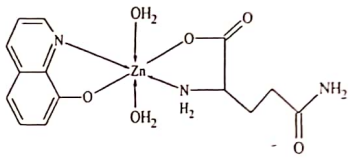
Proposed structures of Zn(II) complexes











4. CONCLUSIONS

The higher decomposition temperature of the complexes indicate a strong metal-ligand bond and electrical conductance studies show non-electrolyte nature of the complexes. Magnetic studies indicate diamagnetic nature of the complexes. Electronic absorption spectra of the complexes show intra-ligand and charge transfer transitions. IR spectra show bonding of the metal ion through N-and O-donor atoms of the two ligands. Thermal analysis confirms the presence of coordinated water molecules.

The antibacterial study shows that complexes are found to be more active against Staphylococcus aureus and Salmonella typhi as compared to Corynebacterium diphtheria and Escherium coli. As compared to standard antibacterial compound, tetracycline, the complexes show moderate activity against selected strains of microorganisms. The biological activity of this complexes is due to bulky structure of the complexes.

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