JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Biological screening and magnetic measurement of Cr (III) complexes of hydrazide

J.R. Gujarathi, T. V. Rajale, S. S. Dipke
Department of Chemistry, Pratap College, Amalner (Autonomous), Dist-Jalgaon(M.S.)India

Abstract

Hydrazide ligands were synthesized by the reaction of acetohydrazide with 3, 5-dichloro-2-hydroxy acetophenone, 5-chloro-2-hydroxy acetophenone and 4, 5-dichloro-2-hydroxy acetophenone. The complexes of Cr (III) complexes were synthesized by chromium chloride with hydrazide ligand in mole ratio 1:2. The ligands and complexes were characterized by Elemental Analysis, ESI-MS, Infrared (FT-IR) spectroscopy, electronic spectra, Nuclear Magnetic Resonance (^{1}HNMR and ^{13}CNMR), magnetism and conductivity measurement. The metal complexes and corresponding ligands were tested against bacterial parasites. It was found that the complexes synthesized showed biological activity than corresponding hydrazide ligands.

Keywords: Metal salt, biologically active metal complexes, antimicrobial activity, MIC.

I. Introduction

Hydrazine carboxamide compounds obtained by condensation of semicarbazide with carbonyl compounds (ketones, aldehydes) [1]. Semicarbazone ligands have nitrogen and oxygen donor atoms and act as neutral or charged ligands [2]. These ligands react with metal ions to form metal complexes [3]. Formation of a variety of metal complexes with these ligands is the development in coordination and bioinorganic chemistry [4]. The complexes with semicarbazones play an important role in agriculture [5], pharmaceutical [6], manufacturing chemistry [7] and it was used as catalysts, in different biological system [8], and used to prepare dyes and polymers [9]. The reported semicarbazone compounds and their metal complexes screened toward many biological functions such as antifungal [9, 10], antitumor [11], antiviral [12], antimalarial and antiparasital activities [8-11]. They were observed for some of their derivatives [10]. The activity of semicarbazone complexes depend on type and charge of metal ions [11]. This work study the Synthesis, characterization and bioassay of Cr (III), Mn (II), Fe (II), and Zn (II) metal complexes with (2E) -2- (4-methoxy benzylidene) hydrazine carboxamide. In this article the synthesis, spectral characterization and

biological studies of four coordinate complexes of Cr (III) with hydrazide ligands have been reported.

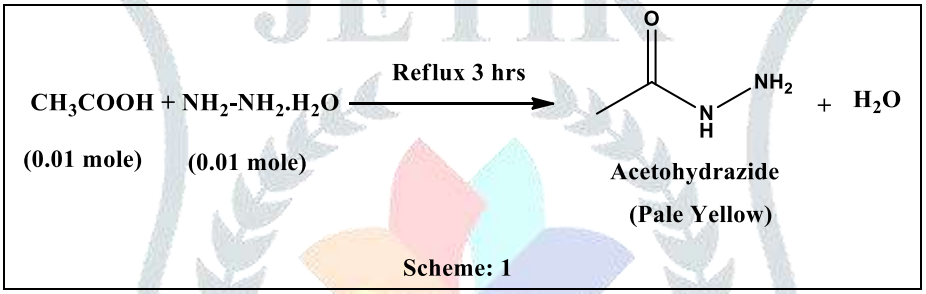
II. Materials and Methods

All the chemicals used are of A.R. grade. Magnetic susceptibility measurement was carried out by Faraday method at room temperature. IR spectra were recorded in solid state in the range 4000-200 cm^{-1} range. Thermo gravimetric analysis was carried out in the temperature range 30-800^{o}C.Metal was estimated by standardized E.D.T.A using muroxide as an indicator and pH-10 buffer solution.

III. Experimental

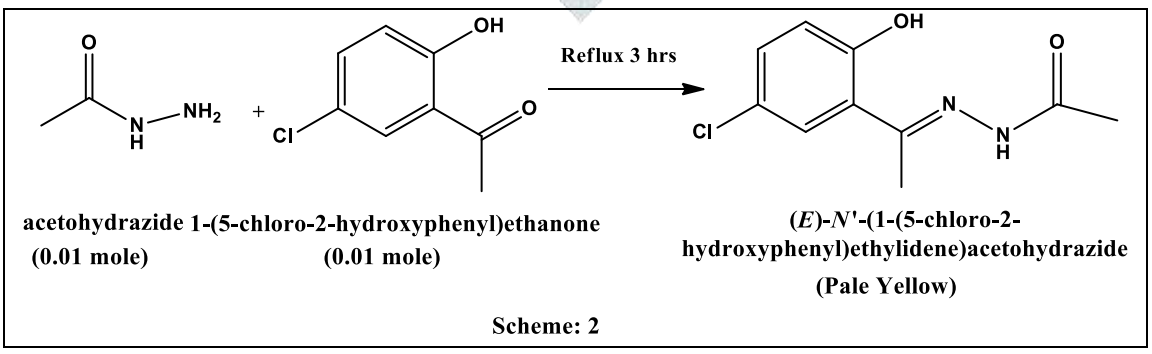
Synthesis of acetohydrazide

20 ml ethanolic solution of glacial acetic acid (0.01 mole) was added to 20 ml ethanolic solution of hydrazine hydrate (0.01 mole) in the mole ratio 1:1. The reaction mixture was refluxed for three hours. On cooling pale yellow product was filtered and washed with hot water then cold ethanol and finally with ether. The compound was then purified in ethanol and dried in vacuum.

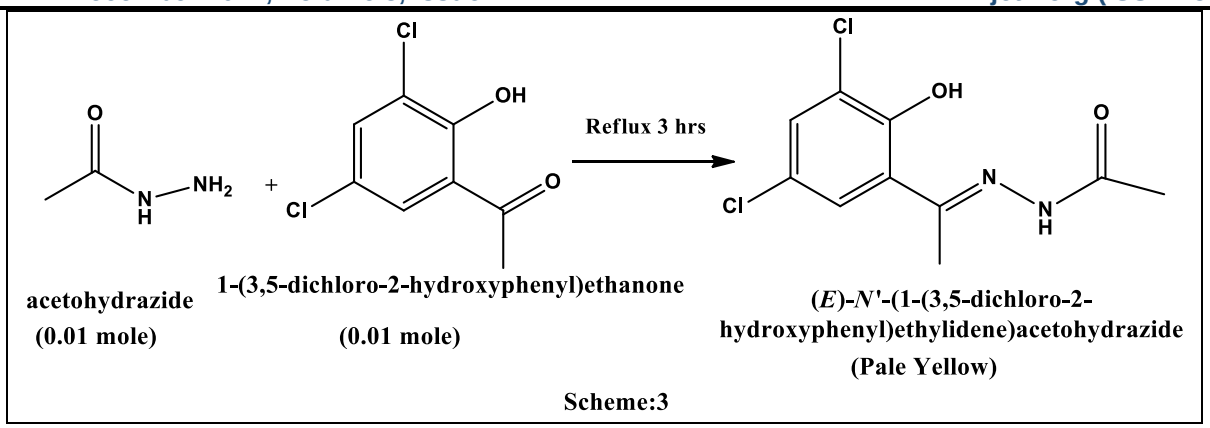


Scheme: 1

20 ml ethanolic solution of acetohydrazide (0.01 mole) was added to 20 ml ethanolic solution 5- chloro 2-hydroxy acetophenone/3,5dichloro 2-hydroxy acetophenone/4, 5 dichloro 2-hydroxy acetophenone (0.01 mole) in the mole ratio 1:1. The reaction mixture was refluxed for three hours. On cooling pale yellow product was filtered and washed with hot water then cold ethanol and finally with ether. The compound was then purified in ethanol and dried in vacuum.

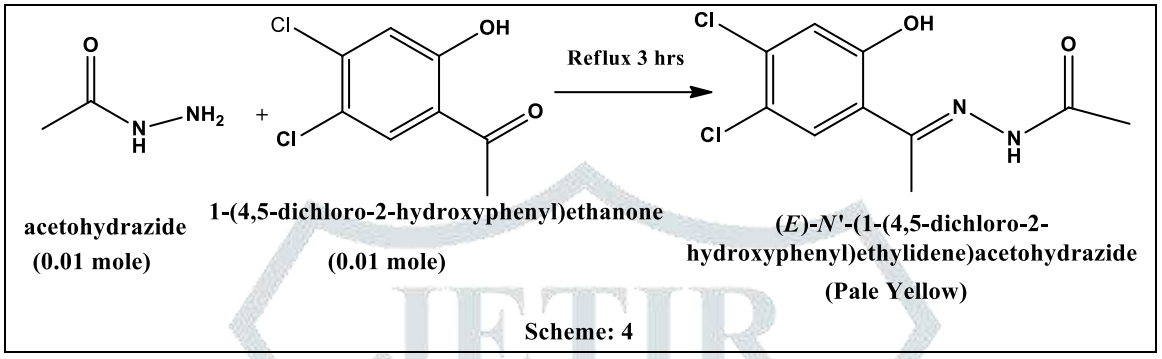


Scheme: 2



acetohydrazide (0.01 mole) + 1-(3,5-dichloro-2-hydroxyphenyl)ethanone (0.01 mole) → (*E*)-*N*'-(1-(3,5-dichloro-2-hydroxyphenyl)ethylidene)acetohydrazide (Pale Yellow)

Scheme:3



acetohydrazide (0.01 mole) + 1-(4,5-dichloro-2-hydroxyphenyl)ethanone (0.01 mole) → (*E*)-*N*'-(1-(4,5-dichloro-2-hydroxyphenyl)ethylidene)acetohydrazide (Pale Yellow)

Scheme: 4

Synthesis of Complex

The complexes of the type Cr.L2 was synthesized by adding slowly ethanolic solution of $CrCl_3.6H_2O$ (0.01 mole) to the hot ethanolic solution of 5-chloro 2-hydroxy acetophenone acetohydrazide/3, 5-dichloro 2-hydroxy acetophenone acetohydrazide/4, 5-dichloro 2-hydroxy acetophenone acetohydrazide (0.01 mole) in the ratio 1:2 and stirring reaction mixture for half hour at 30 ºC temperature. The brown adduct obtained was filtered and washed with hot water to remove excess metal salt, cold ethanol and diethyl ether and dried in vacuum.

Table-1: Physical Properties of the Complexes

Compounds	*Color*	*EmpiricalFormula*	*MagneticMoment(B.M.)*
L	*Yellow*	$C_{10}H_{11}O_2N_2Cl$	-
L'	*Brown*	$C_{10}H_{10}O_2N_2Cl_2$	-
L''	*Brown*	$C_{10}H_{10}O_2N_2Cl_2$	-
Cr.L.	*Brown*	$C_{20}H_{22}O_4N_4Cl_2Cr$	*3.87*
Cr.L'	*Brown*	$C_{20}H_{22}O_4N_4Cl_2Cr$	*3.85*
Cr.L''	*Brown*	$C_{20}H_{20}O_4N_4Cl_4Cr$	*3.83*

IV. Conductivity Measurement

The conductivity was measured in DMF solution and equivalent conductance was calculated. The 0.001 M solutionof complexes were prepared in different percentages of DMF-ethanol mixture and the parameter of solution under study was calculated at temperature 300K, 305K and 310K.

Table- 2: Equivalent Conductance of the Complexes at Different Temperatures

	Equivalent conductance at 300 K			*Equivalent conductanceat 305 K*			*Equivalent conductance at 310 K*		
DMF-Ethanol mixture	*Cr.L.*	*Cr.L'*	*Cr.L''*	*Cr.L.*	*Cr.L'*	*Cr.L''*	*Cr.L.*	*Cr.L'*	*Cr.L''*
75%	*35.4*	*38.3*	*40.2*	*42.5*	*43.4*	*44.2*	*44.6*	*42.3*	*43.2*
80%	*37.8*	*42.3*	*42.5*	*44.6*	*44.3*	*45.5*	*46.8*	*45.3*	*46.6*
85%	*43.3*	*44.8*	*44.5*	*49.2*	*47.8*	*47.5*	*50.5*	*47.6*	*52.5*
90%	*46.4*	*49.4*	*47.3*	*53.3*	*52.4*	*48.3*	*54.4*	*53.4*	*54.3*
95%	*51.4*	*54.5*	*50.8*	*56.3*	*52.5*	*51.8*	*59.3*	*56.5*	*56.8*
100%	*54.3*	*57.3*	*52.5*	*61.3*	*58.4*	*53.5*	*63.6*	*59.6*	*62.2*

^{1}H-NMR (L)

^{1}H-NMR signals at 10.00 and 2.02 ppm and 0.9 ppm are assigned to – OH and O=C-$CH_3$and–N=C-CH_3 protons respectively. Signal at 7.0 ppm corresponds to -NH. Aromatic protons show multiplets at 7.1, 7.5, 6.7, ppm.

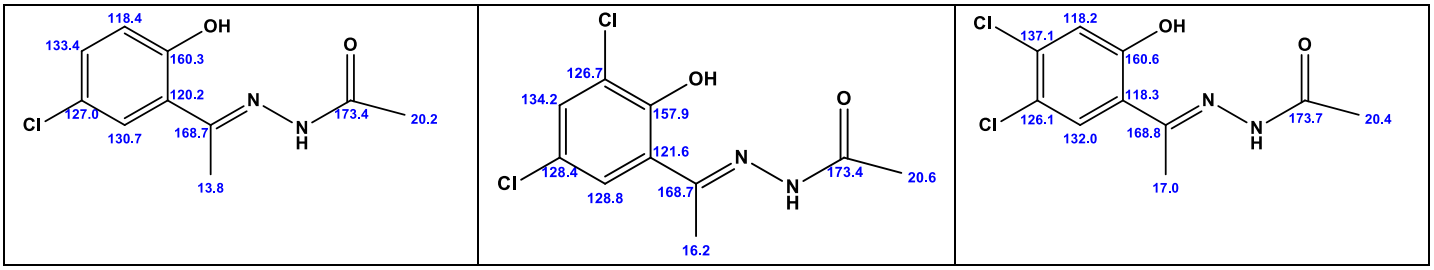
^{1}H-NMR (L')

^{1}H-NMR signals at 10.00 and 2.02 ppm and 0.9 ppm are assigned to – OH and O=C-CH_3 and –N=C-CH_3 protons respectively. Signal at 7.0 ppm corresponds to -NH. Aromatic protons show multiplets at 7.1, 7.3 ppm.

^{1}H-NMR (L'')

^{1}H-NMR signals at 10.00 and 2.02 ppm and 0.9 ppm are assigned to – OH and O=C-CH3 and –N=C-CH3 protons respectively. Signal at 7.0 ppm corresponds to -NH. Aromatic protons show multiplets at 7.4,6.7 ppm.

^{13}C-NMR (L'') δ ppm



ESI-MS m/z, ion M^+ (Calcd.) found

$C_{10}H_{11}O_2N_2Cl$(226.65)226.04, $C_{10}H_{10}O_2N_2Cl_2$(261.09)261.91, $C_{10}H_{10}O_2N_2Cl_2$(261.09)261.73, $C_{20}H_{26}O_7N_4ClCr$ (541.33)541.83,$C_{20}H_{24}O_6N_4Cl_4Cr$(610.22)610.82, $C_{20}H_{22}O_4N_4Cl_2Cr$(585.72)585.82

Table - 3: Analytical Data

Compounds	*Metal Analysis*	*Elemental analysis*			
	M%	*C%*	*H%*	*N%*	*O%*
L	-	*52.11*	*4.89*	*12.36*	*14.84*
		(52.99)	*(4.28)*	*(12.71)*	*(14.12)*
L'	-	*46.71*	*3.12*	*10.09*	*12.72*
		(46.00)	*(3.86)*	*(10.73)*	*(12.27)*
L''	-	*46.85*	*3.04*	*10.11*	*12.79*
		(46.00)	*(3.86)*	*(10.73)*	*(12.27)*
Cr.L.	*9.61*	*44.37*	*4.84*	*10.35*	*17.73*
	(9.10)	*(44.90)*	*(4.04)*	*(10.03)*	*(17.04)*
Cr.L'	*8.52*	*39.36*	*3.96*	*9.18*	*15.273*
	(8.14)	*(39.92)*	*(3.10)*	*(9.92)*	*(15.07)*
Cr.L''	*8.52*	*39.36*	*3.96*	*9.18*	*15.273*
	(8.14)	*(39.92)*	*(3.10)*	*(9.92)*	*(15.07)*

Table - 4: Infrared Spectroscopic Data (cm^{-1})

Assignments	*L*	*L'*	*L''*	*Cr.L.*	*Cr.L'*	*Cr.L''*
ν (-OH)	*3260*	*3260*	*3299*	*3211*	*3260*	*3296*
ν (C= N)	*1672*	*1678*	*1688*	*1560*	*1566*	*1573*
ν (N –N)	*1052*	*1077*	*1082*	*1180*	*1179*	*1184*
ν(N-H)	*3252*	*3259*	*3262*	*3251*	*3259*	*3262*
ν (C–O)	*1292*	*1287*	*1290*	*1212*	*1215*	*1220*
ν(Cr-N)	-	-	-	*452*	*462*	*467*
ν(Cr-O)	-	-	-	*532*	*542*	*550*

Table - 5: Electronic spectral assignments (cm^{-1})

Assignments	*L*	*L'*	*L''*	*Cr.L'*	*Cr.L'*	*Cr.L''*
d-d	-	-	-	*18895*	*18403*	*18523*
L→M	-	-	-	*25700*	*25800*	*25550*
*n→π**	*28700*	*28750*	*28780*	*30789*	*30523*	*30654*
*π→π**	*39800*	*39850*	*39650*	*42200*	*42800*	*42300*

V. TGA Analysis Data

1) Cr.L.:Firststep,122°C,Massloss15.0%secondstep,355°C,Massloss,50.0%ThirdStep660°C,Massloss,72.0%Residue780°C, % ofCr_2O_3, 28.08(28.72).
2) Cr.L'**:**First step, 120°C,Mass loss 9.5% secondstep,354°C, Mass loss, 47.0% Third Step650°C, Mass loss, 77.0%Residue,780 °C, %ofCr_2O_3,24.91(24.10).
3) Cr.L''**:**Firststep,120°C,Massloss8.2%secondstep,365°C,Massloss,49.0%ThirdStep670°C,Massloss,75.0%Residue780°C, % ofCr_2O_3, 24.91(24.10).

VI. Biological Activity (Agar Plate Diffusion Method)

Table - 6: Minimum Inhibitory concentration L, L', L'' Cr (III) complexes and standard

Compound	*Staphylococcusaureu*		*Bacillussubtilis*		*EscherichiaColi*		*Peudomonasaeruginosa*	
	Grampositive				*Gramnegative*			
	2 µg/ml	*2.5µg/ml*	*2 µg/ml*	*2.5µg/ml*	*2 µg/ml*	*2.5µg/ml*	*2 µg/ml*	*2.5µg/ml*
L	*0.67*	*0.38*	*0.70*	*0.42*	*0.70*	*0.42*	*0.68*	*0.42*
L'	*0.62*	*0.32*	*0.62*	*0.34*	*0.61*	*0.33*	*0.64*	*0.31*
L''	*0.60*	*0.30*	*0.61*	*0.30*	*0.60*	*0.32*	*0.62*	*0.31*
Cr-L	*0.54*	*0.29*	*0.53*	*0.28*	*0.57*	*0.27*	*0.53*	*0.23*
Cr-L'	*0.52*	*0.24*	*0.49*	*0.23*	*0.50*	*0.21*	*0.51*	*0.21*
Cr-L''	*0.20*	*0.20*	*0.48*	*0.19*	*0.47*	*0.20*	*0.47*	*0.19*
$CrCl_3.6H_2O$	*0.18*	*0.14*	*0.43*	*0.11*	*0.41*	*0.12*	*0.40*	*0.10*
*Standard**	*0.15*	*0.10*	*0.14*	*0.8*	*0.14*	*0.8*	*0.15*	*0.7*

*Ampicillin

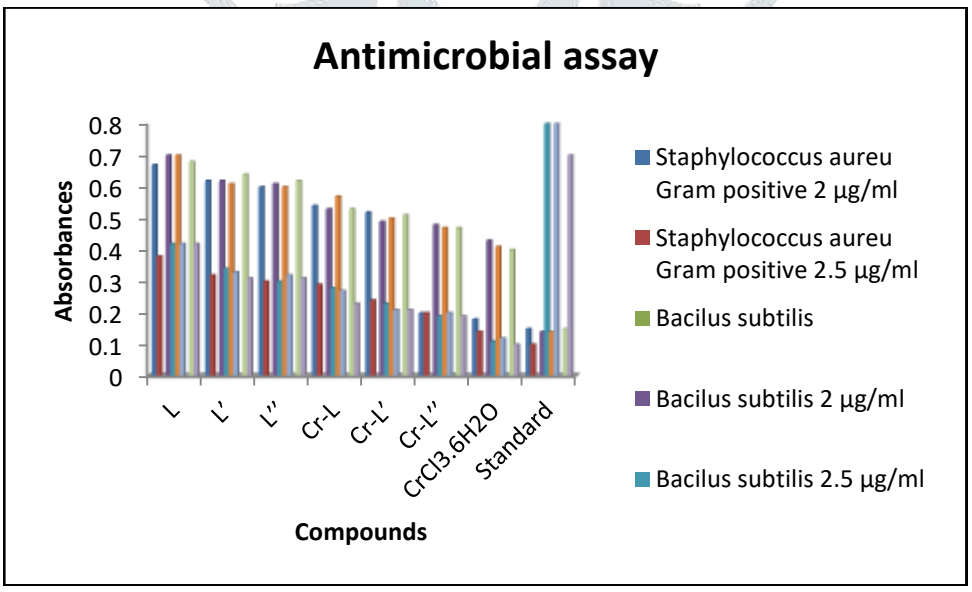


Figure Number-1

VII. Results and Discussion:

The complexes are insoluble in water, methanol and ethanol and soluble in DMF. Mass spectral data confirmed the structure of ligands and complexes as indicated by molecular ion peak (M+1) corresponding to their molecular weights.

The magnetic susceptibility measurement was carried out at room temperature by Faraday method.Cr (III) ion has the electronic configuration [Ar] $3d^4$with four unpaired electrons. It has been pointed out that the stereochemistry is expected to have little effect on magnetic moment of Cr (III) ion, which should be somewhat above the spin-only value of 3.73 B.M. Recently, a large number of Cr (III) complexes having sub-normal magnetic moments at room temperature are reported. The magnetic moments in the present study are in the range 3.80-3.90B.M.

The equivalent conductance of electrolyte solution depends on concentration and temperature.It is found that equivalent conductance of an electrolyte increases with decrease increase in dilution. In dilute solution conductance is more. All complexes show increasing value of conductance with increase in the dilution at 300 K, 305K, and 310 K. The conductivity of an electrolyte depends upon the temperature. The conductivity of an electrolyte increases with increase in temperature. This may be due to at higher temperature the mobility of ions increases and hence more conductivity is observed.

The frequency due to >C=N is shifted to the lower side. This indicates participation of azomethine nitrogen [13] A band at 450-465 cm^{-1}confirms the coordination of azomethine nitrogen [14-17]. There is increase in N-N frequency due to the increase in double bond character off-setting the loss of electron density via donation to the metal. This confirms the coordination of L through azomethine nitrogen atom. The band due to N-H in in the complexes is not affected. The band due to Cr-O in complexes is in the range 530-548 cm^{-1}confirms coordination through oxygen.

L, L', L'' showed bands due to n- π* and π- π*.observedin the range28, 000-29,000 cm^{-1} and 39,000-40,000 cm^{-1}.These bands shifted to higher side on complexation. The L-M charge transfer bands are observed in the range 25,000-26,000 cm^{-1}.The d-d bands are observed in the range 17,000-18,000 cm^{-1}. This shows square planer geometry [18, 19].

Hydrated layer was removed at 120 ^oC. No coordinated water molecules were found. The decomposition proceeded in three steps.The compounds are stable up to about 350 ^oC. The organic molecule was lost up to 650 ^oC. The mass lost corresponding to this step is about 65-70%. The decomposition was complete and metal oxide was formed at a temperature about 780-800 °C.The metal complexes are more stable than organic molecule.

The antibacterial assay was carried out by the agar plate diffusion method. Activity was measured by measuring the absorbance at 517 nm. The minimum inhibitory concentration was determined by liquid dilution method [20]. The solutions with 2 µg/ml, 2.5µg/ml and 3 µg/ml concentrations were prepared in the solvent DMF. The solutions of standard drug ampicillin and metal saltwere also prepared in the same concentration. Inoculums of the overnight culture were prepared. 0.2 ml of the inoculums was added to the test tubes containing the solutions of the compounds of different

concentrations. Sterile water to each of the test tubes was added and these were incubated for 24 hours and observed for turbidity. The same procedure was carried out for standard [21]. Less activity was observed with L, L', L''. This might be due to coordination which reduces the polarity of the central metal atom because of the partial sharing of its positive charge with donor groups and possible π-electron delocalization within the whole chelating ring. So the lipophilic nature of the central metal atom increases, which favors the permeation of the solution of complexes through the lipid layer of the cell membrane [22]. The absorbance is more at 2µg/ml and less at 2.5 µg/ml and no absorbance observed at 3µg/ml. The inhibition is more at 2.5 µg/ml. The chelation theory explains the reason behind the better activity of these complexes. The polarity of the metal ion is minimized to an advanced level, due to the ligand and positive charge of the metal ion with donor groups.

VIII. Conclusion

The synthesized L, L', L'' are bidentate -O, -N donor. The spectral, magnetic data showed octahedral geometry for complexes. The complexes show paramagnetism.The complexes found thermally stable. The decomposition proceeded in three steps. The complexes showed growth inhibitory activity against bacterial species. **The absorbance is found more at 2 µg/ml concentration than 2.5µg/ml**.This suggested increase in concentration of complexes increase the activity. The metal salts showed more inhibitory activity than the ligands.

References

1) N. K. Yadav ,N.K, S. Varshney, K.S , Varshney A.K. Wor. *J. Pharm. Pharma. Sci* ,4 (4) **2015,**1236.
2) Ahsan M.J, Samy J. G, KhalilullahH,Nomani Md. Sh, A *Der Pharmacia Sinica*, , 2 (6) **2011**:107.
3) Dahikar P.M, Kedar R.M, Inter. *J. App. Inn. Eng. Man*., ,2(4) **2013** 8.
4) NavneetA , Pradeep M *J. Zh. Un. Sc*., , 6B(7) **2005** 617.
5) Goel S, Chandra S,.Dwivedi S. Dh, *J. Saudi Chem. Soc*., 20, **2016**, 651
6) Ibrahim M. N, AlDifar H. A, *DerChemicaSinica*, , 2 (1) **2011** 171.
7) Kumar S,.Dhar D.N, Saxena P.N, . *J. Sci. Ind. Res*., 68, **2009** 181.
8) Pelosi G, Op. J. Cry., 3, **2010** 16.
9) Choudhary. Sharma A, R, Nagar M.,.MohsinM ,Meena H. S *J. Chil. Chem. Soc*., , 56 (4) **2011** 911.
10) Kamalpuria T,.Chourey M, Bende N.,.GhuraiyaA Bhardwaj A, *Int. J. Curr. Res. Chem. Pharm. Sci*., 3(5) **2016** 30.
11) Shih M. H, Xu Y. Y, Yang Y. Sh and Lin T. T. *Molecules*, , 20, **2015** 5184 .
12) A. I. Vogel, "Quantitative inorganic analysis ,*2nd edition. Longmans Publisher*, **1962,** London.
13) WestDX,CarisonCS,BouckKJ and LibertaAE,*Transition Met.Chem.*,**1991**,16,27.
14) Butcher RJ and WestDX,*Transition Met.Chem.*, **1993**, 18,449.
15) WestDX,GebremedhinH,Butcher RJand JasinkiJP,*Transition Met.Chem.*,**1995,** 20,84.
16) AkinchanNT,WestDX,YangYH,SalbergMMandKleinTA,*Transition Met.Chem.*,**1995**,20,481.
17) WestDX,Kozub NandBainGA,*Transition Met.Chem.*, **1996**,21,52.
18) MahapatraBBand PandaD,*Transition Met.Chem.*,**1979,** 41**,**809.
19) AliM AandTeohSG, *J.Inorg.Nucl.Chem*,**1979**,41**,**809
20) Shankar K.Muralidhar, Reddy, P,RohiniR,VaddeRavindra, *Der Pharmacia Letter*;1,**2009**,97.
21) ShrivastavaR.S.,*Inorg. ChimicaActa*, Vol56,**1981**,65.
22) Agh-AtabayN.M,DulgerB,Gucin*F.Eur.J. Med.Chem.*402**005**1096.