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Synthesis, Characterization, Antibacterial, Antifungal and Irritant Activities of Organometalic (ll) Complexes of O-Nitro N,N-Dimethylbenzylamine Derivatives

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Abstract

A series of Transition metal complexes have been synthesized by reacting with newly prepared biological active Schiff base ligand .The ligand was prepared by reacting N-bromosuccinimide with O-nitro toluene and reflux for 8hours ,resulting mixture was filtered ,filtrate was o-nitro benzyl bromide which on reaction with dimethyl ammine produce o-nitro N,N-dimethylbenzylamine and characterized by elemental analysis, molar conductivity ,thermal analysis ,X-ray diffraction,IR,UV-Vis spectroscopy and mass spectra. Analytical data confirms the ratio between metal and ligand that is 1:2with octahedral geometry. The IRspectra suggests that ligand behaves as basic bidenate ligand. Molar conductance values suggests non electrolytic nature of metal complexes ,thermal behavior shows more ordered activated state in complex form.

Antibacterial and Anti-fungal activities were performed by using new strains of bacteriaBacillussubtilis,Bacilluspumilus,Sarcinalutea,Streptococcusfaecalis,Staphlococcusaureus,Borditellabronchiseptica and fungal strains used were Trichophyton longiusus, Candida albicans, Aspergillus flavis,Microsporum canis, Fusarium solani, Candida glabrata.

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The biological activities data showed that complexes of Copper, Chromium, Manganese and zinc exhibited more antimicrobial activities than their parent ligand. Maximum antibacterial activity was exhibited by zinc complex. Moderate antibacterial activity exhibited by copper complex and the minimum antibacterial response was reported with manganese.

Keywords: Bidenate Ligand; Transition Metal complexes; Antimicrobial activity; Disc diffusion method; Spectral studies; Irritant activity.

1. Introduction

The schiff base ligands and their metal complexes has many applications in food industry and in medicine .Polymer sciences, biological sciences and used in liquid crystal devices [1]. Transition metal chelates were considered as biological models having various antibacterial activities [2]. Presence of azo group in metal coordination has number of biological applications and shown many antifungal activities [3]. Aromatic carboxylates behave as a schiff base has number of antipoliovirus activities [4]. The herbal drugs used throughout the world have received greater attention in recent times because of their diversity of curing diseases safety and well help to determine models of binding in solid state and to investigate biological activities [5]. The biological activates of transition metal complexes are potent antibacterial and antioxidant agents [6]. Secondary tolerated remedies when compared with conventional medicines. Development of resistance against antibiotics has further emphasized the necessity of research for new therapeutically effective synthetic analogues efficiency is enhanced upon coordination with metal ion [7]. Copper atom played structural and catalytic role in several proteins ,solid complexes have been prepared and characterized physiochemical [8]. It has been recognized as important co-factor in biological molecules either as structural template in protein folding or as a Lewis acid catalyst that can readily adopt 4 ,5 or 6 coordination number [9]. Physiochemical and spectral studies of Copper(II) complexes. The complexes have their own importance in pharmaceutical and medical fields [10]. Metal chelates formed by oximes due to their fascinating chemistry as well as anticancer activities [11] It is a well-known hepatotoxic agent in liver tissues. It was examined that the inhibitory effect of the green tea on cadmium chloride induced antioxidant activity in liver [12].

Phenolic content and DNA protecting in lamiacea plants prevent carcinogenesis through scavenging Cd Cl_2[13]. It was investigated that heat-shock and cadmium chloride increase the protein level in human promonocyetic cells [14]. Mn complex of nitrogen based ligand showed antibacterial and antifungal activity against the microbial straining [15].Manganese has shown varied positive biological properties in reverting diseased conditioning gastro protective. Properties of $MnCl_2$ an acetic acid. Induced ulcer in Wistar rats. Manganese has antiulcer $NiCl_2$ and anti-secretary properties which are comparable to standard drug cimetidine provide beneficial condition to attack the highest density of proteins to MoS_2(molybdenum disulphide) [16].The electronic properties of trivalent lanthanide ions make them luminescent groups with many currently developing application in biotechnology. Lanthanides (Sn,Eu,Th,Dy) used for multiplexing. Er-YAG laser is used for surgical resurfacing. It has ablative properties with water as main chromophore. It was concluded that both proliferation and apoplosis occurred when the laser irradiated the skin [17].

2. Experimental

Analytical reagent grade chemicals and solvents including copper chloride chromium chloride manganese chloride and zinc chloride, Ethanol ,Toluene were purchased from Sigma-Aldrich, Lab Scan and Acro Organics. All chemical and solvents were used without any further purification.

The FT-IR spectra of complex were recorded in the range of 4000-400 cm^{-1} as KBr pallets on Agilent technologies. The elemental analysis of the complexes was carried out by engaging complexes with elemental analyzer (LECO Truspec micro Sr No. 4021 Model No. 630-200-200). Conductivity measurements were performed on Wescan-212 conductivity meter. Mass spectra were recorded on MAT 8500Finnigan 70eV.Melting points were recorded on MP-D Mitamura Riken Kogyo (Japan) electro thermal apparatus was used. Thermal analysis were performed on SDT Q600 V20.9 Build 20.

2.1 General procedure for the synthesis of ligand

Step 1

The ligand was prepared by modification of reported method, N-Bromosuccimide in 250 ml of carbon tetra chloride, o-nitro toluene (0.5mole) and benzoyl peroxide (1 gram) were charged in quick fit flask equipped with water condenser .reflux the mixture for 6 hours ,then it was allowed to cool down and filter off the filtrate was o-nitrobenzylbromide.

Step 2

O-nitrobenzylbromide (prepared in step 1) ,sodium bicarbonate (0.5 mol) and distilled water were taken in quick filled flask equipped with water condenser .Dimethylamine (25.3 ml) was added to reaction mixture with the help of separating funnel drop wise. Mixture was again refluxed for 4 hours then it was allowed to cool and filtered off .Transfer the filtrate to the separating funnel where two layers were formed.

The orange layer on elaboration gave orange oily liquid which is our required ligand o-nitro N,N-dimethylbenzylamine (yield :23%)

2.2 General method for the synthesis of metal complexes

To hot ethanolic solution of ligand (0.5 ml) was mixed with clear solution of metal chloride (2 mol) in distilled water with constant stirring. The pH of reaction mixture was maintained at 7-8. Mixture was stirred for 3 hours. White solid settled which was filtered and washed ethanol and n-hexane to get product (yield 62%)

3. Results and Discussion

The physio-analytical data of ligand and metal complexes is given in (Table 1).The metal complex solutions in DMSO shows little conductance which supports their non-electrolytic nature.

Table 1: Physio-analytical data of ligand and metal compounds

Compound	Mp (^{0}C)	Color	conductance
Ligand(oily)	180(B.P}	Orange	-
Cu-L	235	Green	13.45
Cr-L	265	Brown	15.15
Mn-L	277	Yellow	17.14
Zn-L	196	White	12.20

Table 2: Solubility of metal complexes in different solvents.

Sr #	**Compd/Complex**	**Solubility**			
		DMSO	**Chloroform**	**Ethyl alcohol**	**Mixed solvent system (Ethanol. Toluene. Ethyl acetate)**
1	o-nitro-N,N-dimethylbenzyl amine - (L)	+	+	+	+
2	Cu –L	+	+	+	+
3	Cr-L	Slightly soluble	Soluble	Slightly soluble	+
4	Mn-L	soluble	Soluble	Slightly soluble	+
5	Zn- L	soluble	Soluble	Slightly soluble	+

+ shows solubility

4. FTIR spectra

The FTIR spectrum of ligand shows characteristic bands of at 3000 ,1698, 1602 ,1361 and 1220 cm^{-1} which may be assigned due to $N(CH_3)_2$ which is again confirmed by the bands at 1530 due to the presence of nitro group on dimethylbenzylamine the IR spectra of metal complexes show absence of broad band in the range of

3300-3500 region indicates deprotonation on complexation. This is supported by the appearance of bands towards lower wave number with respect to free ligand which denotes that nitrogen of ligand is co ordinate with metal ion. The IR spectra of metal complexes showed new bands in 400-700 region which can be assigned due to M-O and M-N stretching vibration respectively.

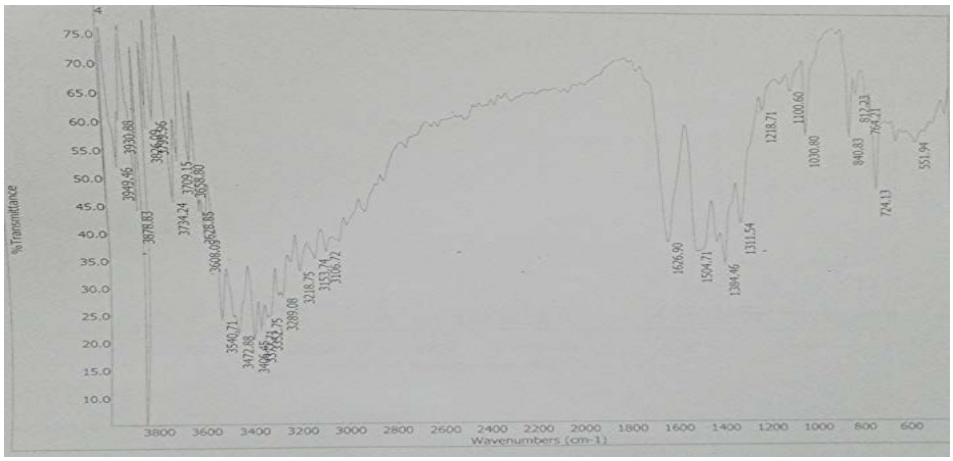

Figure 1: FTIR spectra of coppercomplex.

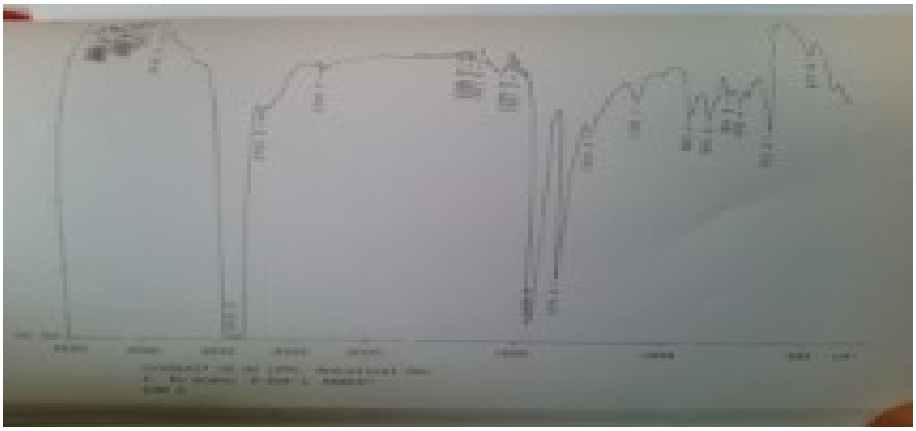

Figure 2: FTIR spectra of zinc complex**.**

Table 3: Characteristic IR absorption frequencies of Compound in cm^{-1} due to bending vibrations for CH group.

Compound	**Observed value (cm^1) CH(bending)**	**Observed value (cm^1) NH(bending)**	**Observed value (cm^1) CH(Stretching)**	**Observed value (cm^1) NH(stretching)**	**Observed value (cm^1) C-N**	**Observed value (cm^1) M-N**
L	1460	1626.90	3106	3279 & 3323	1030 & 1100	
Cu-L	1446	1616	3060	3357	1091 & 1139	1520
Cr- L	1467	1629.70	3033	3305& 3336	1109	1544
Mn- L	1464	1621	3035	3307 & 3338	1103	1567
Zn-L	1457	1634	3032	3335&3358	1150	1559

Similarly stretching vibrations for CH group were observed at 3106 cm^{-1}, 3060 cm^{-1}, 3033 cm^{-1} and 3035 cm^{-1} for ligand and complexes ,respectively. Stretching vibrations for N-H group for ligand and complexes were observed at 3298 & 3323cm^{-1} , 3357cm^{-1},3305 & 3336cm^{-1} and 3307 & 3338cm^{-1}, respectively. Also the stretching vibrations for C-N bond were observed and values observed at 1030 & 1100cm^{-1}, 1091 & 1139cm^{-1}, 1109cm^{-1} and 1103cm^{-1} for ligand and complexes respectively. FT-IR vibrations are shown in table 3..

4.1 Spectroscopic Analysis

The U.V analysis was carried to find out λmax of ligand and metal complexes which showed λmax at 216 nm , 281.0nm , 268 nm, 274 nm and 370 nm respectively (Table 4).

Table 4: Spectrophotometry analysis of complexes

Compounds	Metal complex	Ligand
U.V spectra λmax	281 nm copper complex 268 nm chromium complex 274 nm Manganese complex 370 nm Zinc complex	216 nm

4.2 Elemental analysis of complexes

The elemental analysis of complexes shows the percentage of elements present in metal complexes which is compared with values obtained by theoretical yield , atomic absorption spectra showed the percentage of metals present in metal chelates. The elemental analysis show 1:2 (metal: ligand) stoichiometry for complexes. It corresponds well with general formula ML_2, where M=Cu(ll),Cr(ll),Mn(ll)and Zn(ll).

Table 5: Elemental analysis of complexes

Compound	Nitrogen (calculated)	Sulphur	Hydrogen (calculated)	Carbon (calculated)	% Metal
Copper complex	32.454(20.5)	Nil	4.6786(4.2)	12.577(11.2)	21.96%
Chromium complex	15.96(10.3)	Nil	8.03(6.4)	63.86(57.3)	11.5%
Manganese complex	24.56(18.6)	Nil	6.78(7.2)	54.35(37.34)	33.2%
zinc complex	30.25(21.6)	Nil	7.34(4.2)	60.35(48.55)	46.8%

4.3 *Atomic absorption*

This analysis was carried out by direct method which gave total metal concentration. .Reference standard solution of each metal complex was prepared having concentrations ranges to 2ppm,4ppm,6ppm,8ppm,10ppm.Absorbances of these solutions were measured at the specific wavelength. A graph was plotted between absorbance and concentration of Cu, Cr, Mn and Zn showed a straight line in each case. The concentrations of unknown solutions were calculated from the absorbance of unknown solution by using the standard values

Table 6: Atomic absorption values of metal complexes

Sr. No	Compounds	%of metal(Theoretical)	(calculated)
1	O-nitro N,N dimethylbenzyl amine copper(ll)chloride	23.24	24.44
2	O-nitro N,N dimethylbenzyl amine chromium(ll)chloride	31.78	32.02
3	O-nitro N,N dimethylbenzyl amine manganese(ll)chloride	48.30	51.72
4	O-nitro N,N dimethylbenzyl amine zinc(ll)chloride	34.45	37.87

4.4 X-ray Powder diffraction analysis

The structure of complexes of copper, zinc and manganese were elucidated x-ray diffraction technique. The complexes obtained in powder form were gently grounded in an agate mortar then powder of each complex was deposited in sample holder equipped with silicon zero –background plate. The diffraction data were collected by scans in the 2 θ range of $20° - 80°$ by using a advanced refrectometer equipped with λ Source Cukαx_1 = 1.54 $°A$. PANalytical X PERT Pro Voltage = 40 KV current = 40^{-1}mA $\theta = 20° - 80°$.Standerd peak search followed by visualizing the intensity we can find a size of crystallite .The diffractogram of Cu complex shows 18 reflections with maxima at 2 theta s equal to 32.798the corresponding d value is 2.477^0 A. the diffractogram of Mn complex had 11 reflections with 2 theta is equal to 86.658 ^{0}A,corresponding to d value 1.087 ^{0}A whereas the diffractogram of Zn complex had fourteen reflections with maxima 2theta values is equal to 23.11^0A corresponding to d value 3.845^0A.The X-ray diffraction pattern of these complexes with respect to major peaks shows intensity 10% greater than indexed by using computer program. Cu complex shows values of lattice constants a=8.364A,b=7.848A,c=7.761A and alpha =gamma=90degrees and beta =118.40degreesand unit cell volume is equal to$468.67A^3$.Mn complex yield values of lattice constants a=14.152A,b=6.156A,c=4.456A also alpha ,beta and gamma is equal to 90degrees and unit cell volume =$385.605A^3$,the required crystallographic data of Mn fulfill the requirement for the compound to be ortho rhombic .Zn complex have values of lattice

constants at a=14.546A, b=5.732A c=9.940A .alpha and gamma is equal to 90 degrees and beta =97.396, volume of unit cell is equal to97.453A^3.the condition required for the compound to be monoclinic were found satisfactory.

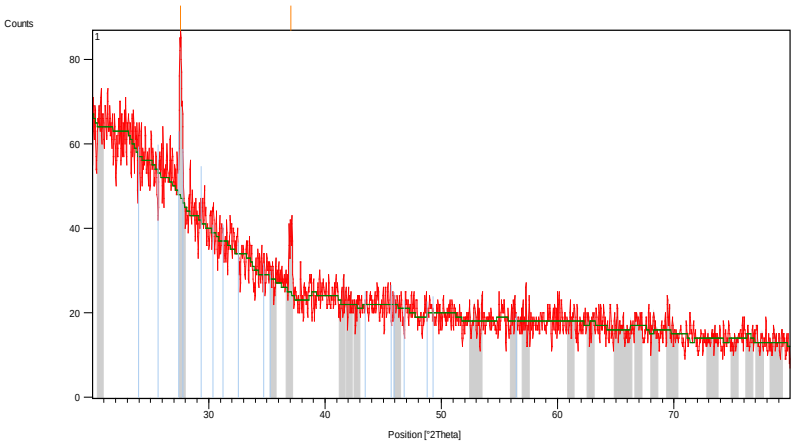

Figure 4: XRD spectra of zinc complex.

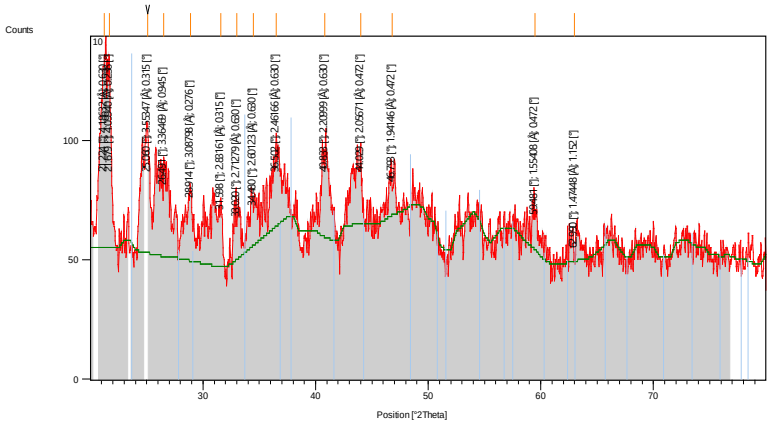

Figure5: XRD spectra of copper complex.

4.5 Thermal analysis

The TGA of metal complexes indicates the loss in **weight** in the range from room temperature to 186^{0}C which is equivalent to 3.86 percent it indicates the loss of water, which is shown by endothermic peak. Further decomposition takes place beyond this temperature from 186-405^{0}C.corresponds to loss in mass of 28.54percent in the TG curve which indicates the expulsion of nitro group from the complex. The decomposition occurs in the temperature range 405 -530^{0}C indicates loss of benzyl group, further at temperature range 530-750^{0}C loss of 26.57percent occurs indicating loss of dimethyl ammine. At 750^{0}C horizontal portion of the curve indicates the presence of thermally stable residual metal oxide .the percentage of residual metal oxide was found to be 24.21 which is very close to theoretical value, TGA of Cr(II) complex shows weight loss corresponding to mass

loss 58.63 percent. This loss corresponds to loss of coordinated water molecule with ligand part of complex in the range for room temperature to 235^{0}C.Furthur decomposition at 235-525^{0}C loss of 13.50 percent was occurs indicating loss of carbonyl group with chloride part of complex. The end product of decomposition is formation of Chromium Oxide, weight corresponds to 27.18 percent which is equal to theoretical value 27.58..Similarly TGA spectra obtained for manganese complex and zinc complex can be interpreted and shown in table 7

Table 7: Thermal analysis of Cu(ll),Cr(ll),Mn(ll) and Zn(ll) complexes

Complexes	Massloss%obs(calc)	Temperature(^{0}C)	Expected nature of decomposition
Cu –L	3.86(3.81)	R.T-186	Loss of water
	28.54(27.33)	186-405	Expulsion of nitro group
	26.57(29.24)	405-530	Loss of benzyl group
	24.21(24.55)	530-750	Dimethylamine with carbonyl part
	16.63(16.93)	750-1000	Residue
Cr –L	3.45(3.49)	R.T-175	Loss of moisture
	26.43(27.33)	175-405	Expulsion of nitro group
	24.92(25.01)	405-498	Loss of benzyl group
	20.53(20.63)	498-723	Dimethylamine with carbonyl part
	24.21(23.85)	723-1000	Residue
Mn-L	58.63(58.75)	120-235	Loss of moisture
	13.50(13.61)	235-525	Loss of benzyl group from dimethylamine
	27.16(27.47)	525-1000	Residue
Zn –L	10(10.34)	R.T-115	Loss of moisture
	50.56(50.44)	215-310	Degradation of complex
	15.00(14.67)	280-330	residue

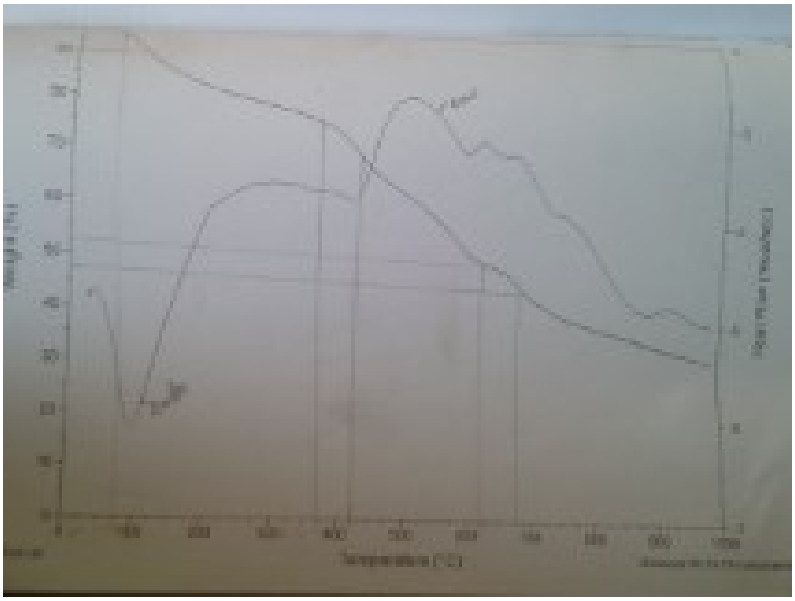

Figure 6: TGA spectra of zinc complex

4.6 Mass Spectral Data of organocopper(ll)derivatives of o-nitro N,N Dimethylbenzylamine

The main fragment ions observed for ligand as well as for copper and zinc complexes are listed in table. The molecular ion peak for is observed at m/z 257 for o-nitro N,N Dimethylbenzylammine.and at 394 and 428 for copper and zinc .In both the complexes the primary fragmentation is due to loss of dimethylammine,while secondary and tertiary fragmentation is due to fragmentation of nitro group and benzyl group which is in close agreement with thermal analysis .

Table8: Mass spectral analysis of ligand and its derivatives with zinc and copper.

Compound	Base peak($M^{+)}$	Fragmentations
Ligand	255	213,167,153,144,128
Cu-L	480	394,268,222,205,167,122
Zn-L	475	428,305,259,234,189,156

5. Antimicrobial Activity

Disc diffusion method was used to test the antibacterial and antifungal activity. Different strains (bacterial and fungal strains) were engaged to check the antibacterial and antifungal activities .The microorganisms were obtained from Agricultural department Laboratory from University of Punjab, Lahore. They were maintained on a slant on nutrient agar in MC- cartnery bottles and stored at 121^{o}C.

5.1 Antibacterial activity

Different strains were used to test the antibacterial activity The selected strains were Bacillus subtilis, Bacilluspumilus, Sarcinalutea, Streptococcusfaecalis, Staphlococcusaureus, Borditellabronchiseptica. The ligands and metal complexes were employed for antimicrobial activity by using Disc diffusion method. Nutrient agar was mixed in distilled water and dispersed homogenously. Sterilization of the medium was carried out by means of autoclave at 121 ^{o}C for 20 min. Medium was treated with Inoculums before it was transferred to Petri plates. Hereafter, filter paper discs were placed parallel on growth medium which contains 100 µL (micro liters) of complexes and ligands, respectively. The incubation of Petri plates was taken for 24 hours at 37 ^{o}C for bacterial growth. The complexes and ligands that exhibited the antibacterial activities well, inhibited the growth of bacteria and formed clear zones. Zone reader was employed to measure the inhibition zones in mili meters. The standard drug used was Ampicillin , Cephalexin[18].

5.2 Antifungal activity

Fungal strains were used to test the antifungal activity. The selected strains were Trichophyton longiusus, Candida albicans, Aspergillus flavis, Microsporum canis, Fusarium solani, Candida glabrata. The growth medium was synthesized, sterilized and then transferred to the Petri plates. Petri dishes were incubated for 48 hours at 28 ^{o}C for fungus growth. Filter paper discs were cited on growth medium for the growth of fungus. The complexes and ligands were applied up to 100 µL (micro liter) on each disc. Petri plates were then incubated. The complexes and ligands that exhibited the antifungal activities inhibited the growth of fungus and clear zones were produced. The standard drug used in order to compare the antifungal potential of the complexes and ligands was Micanazole, ketoconazol.

Table 9: Antibacterial Activity for metal (ll) derivatives of nitro N,N-Dimethylbenzylamine Standard drug ;Ampicillin ,Cephalexin

Name of bacteria	**Cu complex Zone of inhibition(nm)**	**Cr complex Zone of inhibition(nm)**	**Mn complex Zone of inhibition(nm)**	**Zn complex Zone of inhibition(nm)**
Bacillus subtilis	10	10	10	16
Bacillus pumilus	-	10	17	10
Sarcina lutea	-	10	10	-
Streptococcus faecalis	10	11	12	-
Staphylococcus aureus	11	-	11	11
Burdetella bronchiseptica	-	12	-	13

Table10: Antifungal Activity for metal (ll) derivatives of nitro N,N-Dimethylbenzylamine Standard drug;Micanazole, ketoconazole Concentration:2ooug/ml.

Name of Fungi	Cu complex Percent Inhibition	Cr complex Percent Inhibition	Mn complex Percent Inhibition	Zn complex Percent Inhibition
Trichophyton longfusun	55.5	40.3	89.4	63.4
Candida albicans	0	0	0	0
Aspergillus flavus	33	0	57	24
Microsporum canis	0	0	60	78
Fusarium solani	0	0	0	23
Candida glaberate	0	0	46	12

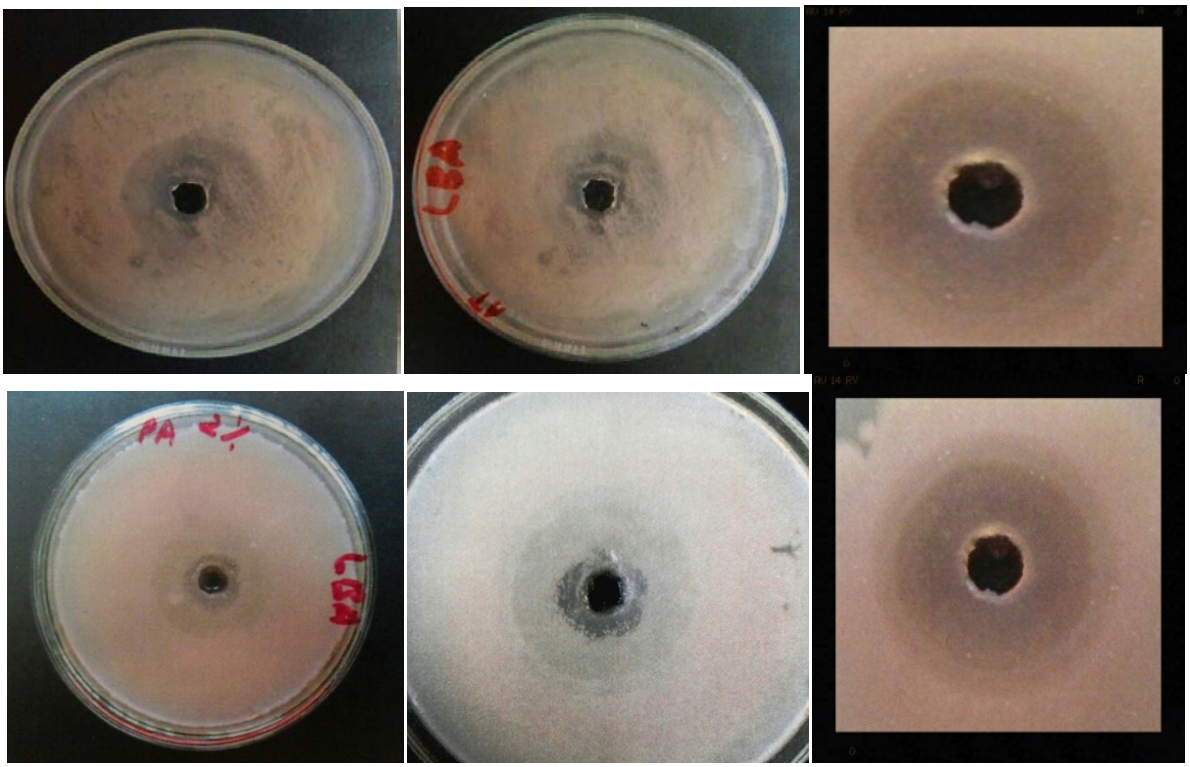

Figure 7: Slides showing anti-bacterial screening of metal complex.

6. Determination of Irritant activity

Albino rabbit (oryctolagus cuniculus) having weight 1kg from veterinary research institute, Lahore was purchased ,it was fed on animal fodder provided with tapwater, it was used to test the irritant activity of organometallic complex. For testing the irritant activity hairs present on the ears was shaved off and divided in to three parts with the help of marker about 2microliter of different concentration of metal complexes was applied on three portions .The other ear is taken as control .The redness of ear was observed after every

15minutes and then after 30minutes .The maximum irritancy on rabbit ear that correspond to the ++scale of Hecker in1971 after 24 hours were recorded. Neither acute nor chronic irritant activity has been exhibited by metal complex as earlier reported [18] Results excluded from antibacterial screening is that transition metal complex show high inhibition towards bacteria AcidovoraxTanpon medium inhibition is shown by Burdetellapertussis. The diverse bioactivity help me to synthesize new bioactive compounds having different mode of action. Bacteria present cause serious threats to our environment and causes morbidity. Organomettalic zinc complex is considered as new biologically active compound having great antibacterial activity against pathogenic bacteria.

7. Conclusion

Metal complexes of Cu(II) ,Cr(II),Mn(II),and Zn(II) were synthesized, by using a new ligand obtained by condensation condensation of ortho nitrobenzylbromide, with Dimethylamine in the presence of sodium bicarbonate yield o-nitro N,N-Dimethylbenzylamine .Ligand formed bidenate complexes having octahedral geometry. These complexes were characterized by different physiochemical and spectroscopic techniques. The biological activity shows that zinc complex has shown maximum antibacterial activity .Cu complex has shown moderate antibacterial activity against six species of bacteria and .Mn has minimum antibacterial response.

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References

[1]. Brandt,E.G.,Hellgren,M.,Brinck,T.Bergman,T.and Edholm, Molecular dynamics study of zinc binding to cysteines in a peptide mimic of the alcohol dehydrogenize structural zinc site. Physical chemistry,11(6) 975-998.2009

[2]. Broadley ,M.R. ,White, P.J.,Zelko,I.and Lux ,.Zinc in plants .News Phytologist,173(4)677-702.2007.

[3]. Chandra,S. and Kumar ,EPR,IR and electronical spectral studies on Mn(II),Co(II),Ni(II) and Cu(ll) complexes with a new22 membered azamacrocyclic ligand .Spectrochimica Acta Part A Molecular and Bimolecular spectroscopy 60(8-9),1751-1761.2004.

[4]. Chohan,Z.H.,Shaikh,A.u.,Rauf,andShpuran,C.T.,2006antibacterial,antifungal and cytotoxic properties novel N-substitute sulfonamides from 4-hydroxycoumarine.journal of Enzyme inhibition sand medicinal chemistry,21(6),741-744(2006) .

[5]. Despaigne ,R.,DA Silva ,J.G,Do carmo,A.C.M.,Piro, Castellan ,E.E .and Beraldo ,H..Copper(II)and Zinc(II)complexes with 2-benzoylpyridine-methyl hydrazones .Journal of molecular structure O.E,920(13)102.2009,

[6]. Deevi, S.c. and Sikka, V.K. ,.Nickel and Iron aluminizes an overview of properties ,processing and application Intermetallics Journal of Biomedicine sciences,4(5),357-375.1996.

[7]. Fosmire, Zinc toxicity .The American journal of Clinical Nutrition,51(2),225-227,1990.

[8]. Heller ,A. ,Potentially implant bleminiaturebatteries. Analytical and Bioanalytical chemistry.385(3),469-473.2006

[9]. Khan,Z,akram and kabir-ud-din ,Oxidation of Lactic acid by water soluble mangenese dioxide .International journal of Chemical Kinetics ,36(6),359-366.(2004)

[10]. Navomoney and Bhole,D.S Nucleophilic addition of hydroxylamine.methyloxiamine and Hydrazine to Malonitrile oxime .Journal of Organic Chemistry,65(4),1139-1143.(2000)

[11]. Raman,N.,Raja .D.J.and Sakthivel,A. Synthesis spectral characterization of Schiff base transition metal complexes DNA cleavage and antimicrobial activity .Journal of Chemical sciences ,119(4),303-310.2007

[12]. Saibabu, Timmons and Li..Vicina diamino functionalities as structural elents inbiologically active compounds .Chemical biology and drug design ,67(2)1219-1226.(2006)

[13]. K,Peariso, C.w .Goulding, S.Huang, J.Epenner-Hahn Specroscopic studies of some Schiff bases derived from 2-Aminobenzothizole .Journal of the Chinese .Chemical .Society Vol 120,8410-8416,(1998).

[14]. Kalnicky and Singhvi .Field portableXRD analysis ofenviornmental samples Journal of Hazardous materials 83(1),93-122,2001

[15]. A.S Kumar SR Shimpi, PP Mahulikar and RS Bendre Synthesis antibacterial activity of M(ll)schiff base complex Journal of Scientific and Industrial research Vol 65, 665-669.,2006.

[16]. Najma Sultana, Asianaz, M. Saeed Aryan(2010) Synthesis characterization,antibacterial,antifungal and immunomodulating activities of gatifloxacin-metal complexes. Journal of Molecular Structure d 969, 17-24

[17]. Javed Sheikh Harjeet Juneja, Vishwas Injle Synthesis and in vitro biology of Co(II),Ni(II),Cu(II) and Zinc(II) complexes of functionalized beta-diketone bearing energy buried potential antibacterial and antiviral O,O pharmacophore sites K Journal of Saudi Chemical Society Vol 17, 269- 276,2013.

[18]. Salami A.T Nd ukavb)a N.G, Lyiola T.O Agbola O.F , Olvwole F.S & Olabye S.B Gastroprotective properties of Manganese Chloride on Acetic Acid induced Ulcer in Wister Rats African journal of biomed research , unit vol 17, 109, 117.,2014.