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Trinuclear Schiff Base Complexes Containing P-Phenylene Diamine, 2, 3-Pentanedione and 3-Aminocoumarin Ligand: Synthesis, Characterization, DNA Cleavage and Antimicrobial Activity

Kuttiyapillai Sivakumar, Venkatachalam Chandrasekaran

Abstract: Trinuclear Schiff base complexes were synthesized by using p-phenylene diamine, 2,3-pentanedione and 3-aminocoumarin and Cu (II), Ni (II), Mn (II), Zn(II) and Cr(III) chloride salts. The category of compound was [M_3LCl_6]. All trinuclear compounds were analyzed by C, H&N analysis and spectral studies. Mechanism of thermal analysis of trinuclear Schiff base metal complexes was studied. The electrophoresis data confirmed that Schiff base compounds cleaved DNA with Hydrogen peroxide. Additionally, the antibacterial action was tested by disc diffusion method. The efficiency of compounds was assessed against selected microbes. The result of minimum inhibitory concentration confirmed that trinuclear Schiff base metal compounds have got more efficiency.

Keywords: p-phenylene diamine, 2,3-pentanedione and 3-aminocoumarin C, H & N analysis, DNA cleavage study and thermal analysis

I. INTRODUCTION

Schiff base combines with metal ions to form coordination complex. The reason for formation of many complexes is because of simple complexing property of Schiff base. It plays vital role in Chemistry due to easy preparation and usefulness. Schiff bases contain azomethine group formed from carbonyl group and imino group. Nitrogen leads to the development of coordination between a metal ion and Schiff base. Schiff bases having atoms such as N-atom, S-atom, are used as drugs. It causes the creation of six member chelate rings when coordinated with different metal ions. Schiff bases having aryl substituents are more stable and simply prepared compared with Schiff base having alkyl substituents. It is known that Schiff bases containing aliphatic aldehydes are comparatively not stable and they readily go through polymerization compared with Schiff bases having aromatic aldehydes. Usually, the preparation of Schiff bases from carbonyl group needs a protic solvent. It must be dry to avoid potential hydrolysis of the produced imine bond. The formation is generally undertaken under the acid or base catalysts. The completion of azomethine formation is proscribed by the partition of the product or release of water, or both. The coordination compounds containing transition metal complex with Schiff base ligand can be used as antitumour [1-2], antifungal [3], anticancer [4], antioxidant [5] agents. Hence, synthesis and characterization of Schiff base metal complex plays important role. The Schiff base complexes having O_2 are valuable in biological and industrial process. They are used in organic synthesis, pigment industry, polymer industry, textile industry, and dyestuff industries. A number of Schiff base pigments are used in textile and rubber industries and also in the manufacture of varnishes and printing inks. Schiff bases are used as analytical reagent for analyzing transition metals. After adding oxidant hydrogen peroxide, the cleavage activity of calf-thymus deoxy Ribo nucleic acid was induced by compounds. It was examined by Gel electrophoresis method [6]. The antibacterial action of the synthesised compounds against microorganisms *Staphylococcus aureus, Klebsiella pneumoniae and Escherichia coli* was tested by disc diffusion method [7]. The structural elucidation was completed by elemental analysis and spectral studies such as IR, UV, CV, EPR, magnetic measurements and thermal analysis.

II. EXPERIMENTAL DESIGN

Synthesis of mono nuclear Schiff base complex

P-phenylene diamine and 2,3-pentane dione were mixed leisurely with consistent stirring. They were boiled with ethanol solution in Rb flask for 3hours. Next, it was mixed with copper chloride and further refluxed for 1 hour. Precipitate was composed, filtered, washed by using ethanol and further it was desiccated. Other mono nuclear metal complexes were prepared by same method.

Preparation of trinuclear Schiff base metal complexes

Mono nuclear Schiff base copper (II) complexes and 3-amino coumarin were refluxed for 3 hours. It was mixed with copper chloride and further refluxed for 1 hour. After cooling, the copper compound was obtained, filtered and dried. Other metals such as Ni(II), Mn(II), Zn(II) and Cr (III) trinuclear compounds were furthermore synthesized by same methods.

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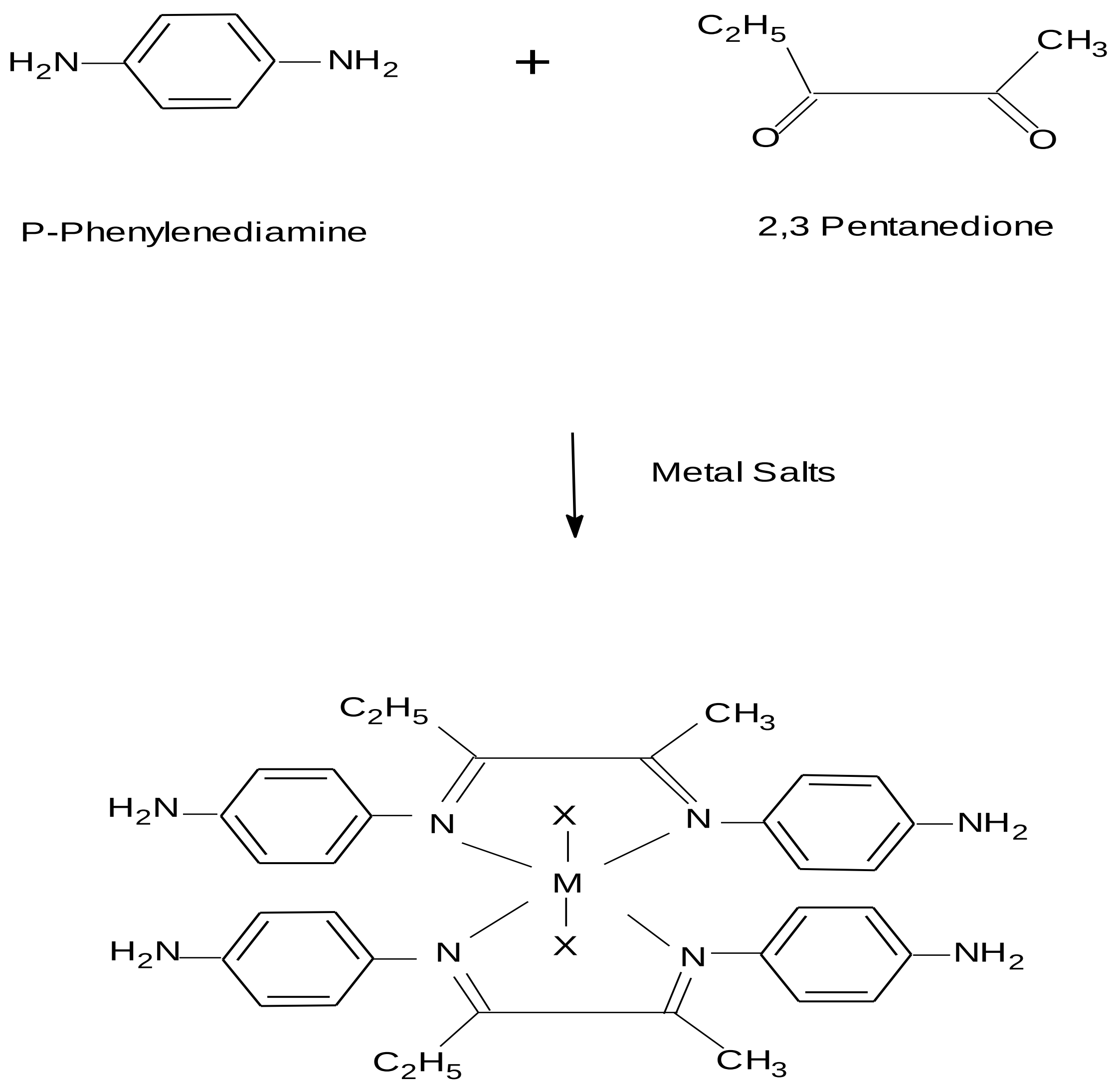
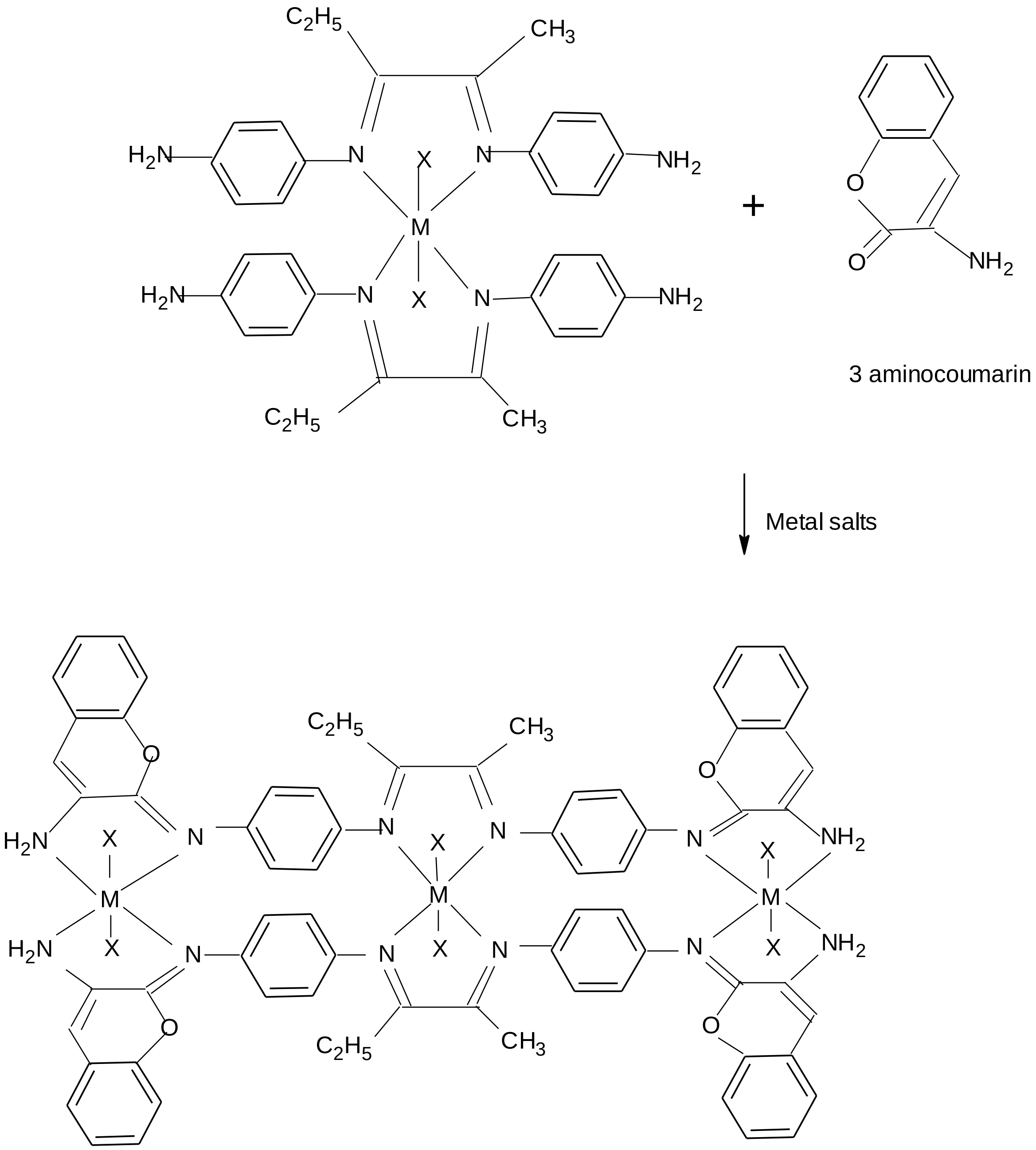


M=Cu, Ni, Mn, Zn & Cr

X=Cl

Scheme 1. Preparation of mononuclear compounds



M=Cu, Ni, Mn, Zn & Cr

X=Cl

Scheme 2. Preparation of trinuclear compounds

III. RESULTS AND DISCUSSIONS

Elemental analysis (C, H & N analysis)

The data of C, H & N method of the compounds was mentioned in Table 1. The category was ML, where M represented Cu(II), Ni(II), Mn(II), Zn(II) and Cr (III) ions, while L represented ligand. Theoretical values were in good agreement with experimental values.

The Schiff base complexes were dissolved in Dimethyl formamide initially. The values were indicated in Table 1. It was decided that molar conductivity of $[Cu_3C_{70}H_{60}N_{12}O_4Cl_6]$, $[Ni_3C_{70}H_{60}N_{12}O_4Cl_6]$, $[Mn_3C_{70}H_{60}N_{12}O_4Cl_6]$, $[Zn_3C_{70}H_{60}N_{12}O_4Cl_6]$ and $[Cr_3C_{70}H_{60}N_{12}O_4Cl_6]$ compounds were at 12.54 – 19.10 Ohm^{-1} cm^2 mol^{-1}(Table 1). Schiff base complexes were non-electrolyte and chloride ions were in the sphere.

Table 1: Elemental analysis of the Schiff base complexes

Complexes	% C		% H		% N		% of metal		Λ_M (Ohm^{-1} cm^2 mol^{-1})
	Calc.	Exptl.	Calc.	Exptl.	Calc.	Exptl.	Calc.	Exptl.	
$[Cu_3C_{70}H_{60}N_{12}O_4Cl_6]$	54.73	54.78	3.94	3.97	10.93	10.96	12.40	12.36	12.54
$[Ni_3C_{70}H_{60}N_{12}O_4Cl_6]$	55.25	55.28	3.98	3.95	11.04	11.07	11.56	11.59	16.26
$[Mn_3C_{70}H_{60}N_{12}O_4Cl_6]$	55.66	55.64	4.00	4.04	11.12	11.15	10.90	10.94	18..24
$[Zn_3C_{70}H_{60}N_{12}O_4Cl_6]$	54.53	54.51	3.92	3.95	10.90	10.94	12.71	12.75	15.65
$[Cr_3C_{70}H_{60}N_{12}O_4Cl_6]$	55.99	55.96	4.03	4.08	11.19	11.23	10.38	10.34	19.10

IR spectra

The coordination mode can be elucidated by IR spectra. The IR bands at 1590−1610 cm^{-1} is typical band of azomethine ν(C=N) group. There was no peak around 1700 cm^{-1} for ν(C=O) group and it revealed that condensation of carbonyl group and amino group to form azomethine. The bands at 1530−1592 cm^{-1} attributed to ν(C=N) and ν(C=C) groups. The bands at ~2910−3105 cm^{-1} supported to ν(C−H) stretching vibrations.

The IR band at ~3400 cm^{-1} attributed to ν(N−H) group. The band at 3309−3323 cm^{-1} was attributed to the coordination between mononuclear Schiff base compounds and 3-amino coumarin and also the amine of the 3-amino coumarin linked to the metal and formed the steady trinuclear Schiff base compounds.

The far IR bands at 595−615cm^{-1} supported to ν(M−N) group. The bands at 592−607cm−^{1} created from (M-N) and provided suggestion about the linkage of azomethine nitrogens. The bands at 355-368 cm^{-1} is contributed to ν(M−Cl) vibrations [8-10]. The IR results were mentioned in table 2.

Ultraviolet-visible spectra (UV)

The Ultraviolet-visible spectra are very essential in elucidating structure. Electronic spectra of each and every one compound were analysed. The results are given in Table 3. The peaks at 276-292 nm, 312-334 nm and 368-412 nm were ascribed to the intra ligand charge transfer (LCT) transition (π→π*) because of transitions relating molecular orbital positioned on the benzene ring of the ligand groups, allocated to (n→π*) transition because of azomethine groups and benzene ring of the ligand groups and LMCT transition respectively. The bands at 640-660 nm are ascribed to d−d transitions concerning the metal orbitals.

The UV spectra of mononuclear copper (II) compound provided peak at 580 nm assigned to the d-d transition $^2E_g \rightarrow {}^2T_{2g}$ (580 nm) of Cu(II) ion indicating a distorted octahedral geometry. In addition, UV data of the mononuclear Ni (II) compound revealed two d-d transitions. The two bands of Ni (II) at 710nm, 590 nm accredited to $^3A_{2g} \rightarrow {}^3T_{2g}(F)$, $^3A_{2g} \rightarrow {}^3T_{1g}(F)$ signifying a distorted octahedral configuration around the Ni (II) ion. The UV data of Mn (II) compound exhibited four weak absorption bands between 540nm−700nm attributed to $^6A_{1g} \rightarrow {}^4T_{1g}(4G)$, $^6A_{1g} \rightarrow {}^4E_g(4G)$, $^6A_{1g} \rightarrow {}^4E_g(4D)$, $^6A_{1g} \rightarrow {}^4T_{1g}(4P)$ confirming octahedral geometry.

In the case of homo trinuclear Cu (II), Ni (II) and Mn (II) compounds revealed consequent metal ion d-d transitions. Alternatively, some of the additional band at 560−780 nm confirmed more metal ions present in the coordination sphere [11-13]. Therefore, octahedral geometry was established by UV-Vis spectra. The UV results were mentioned in the table 3.

Table 2: IR spectra of the compounds

Complexes	(C=N) (cm^{-1})	NH_2 (cm^{-1})	(M-N) (cm^{-1})	(M-Cl) (cm^{-1})
$[Cu_3C_{70}H_{60}N_{12}O_4Cl_6]$	1590	3318	592	355
$[Ni_3C_{70}H_{60}N_{12}O_4Cl_6]$	1604	3323	596	358
$[Mn_3C_{70}H_{60}N_{12}O_4Cl_6]$	1596	3309	606	364
$[Zn_3C_{70}H_{60}N_{12}O_4Cl_6]$	1610	3310	602	360
$[Cr_3C_{70}H_{60}N_{12}O_4Cl_6]$	1602	3318	607	368

Cyclic voltametry studies

The redox behaviour of tri nuclear Schiff base compounds was tested by cyclic voltametry in DMF over the scan rate 0.1 Vs^{-1}. The results of the compounds are listed in Tables 4 and 5. Cathodic (E_{pc}) and anodic peak potential (E_{pa}) were calculated.

Trinuclear $[Cu_3(L^4)\ Cl_6]$ compound provided three quasi reversible reduction waves. Controlled potential electrolysis (CPE) was conducted at 100 mVs^{-1} and data revealed that every pair was in contact to one electron transfer (OET) process. Therefore, the process was arranged as given below

$$Cu^{II}Cu^{II}Cu^{II} \rightarrow Cu^{II}Cu^{II}Cu^{I} \rightarrow Cu^{II}Cu^{I}Cu^{I} \rightarrow Cu^{I}Cu^{I}Cu^{I}$$

The first and second reduction potentials are assigned to the reduction of Cu (II) in the terminal compartments. The third reduction waves are attributed to reduction of copper (II) in central compartment. The $[Cu_3(L^4)\ Cl_6]$ compound appeared a three quasi reversible oxidation waves attributed to copper (III)/copper (II) couple.

The ΔEp results implied that every pair was quasi reversible. The $E_{1/2}$ results specified that every pair correlated to one electron transfer (OET) process.

The compound $[Ni_3(L^4)\ Cl_6]$ appeared three quasi reversible reduction waves. The first, second and third reduction potential of the compound in the range $E^1_{pc} = -1.85$ V, $E^2_{pc} = -1.56$ V $E^3_{pc} = -1.17$ V are attributed Ni (II). The ΔEp data implied the presence of a quasi-reversible couple. The $E_{1/2}$ results specified that every pair correlated to one electron transfer (OET) process. Tables 4 and 5 signified the cyclic voltametry data of $[Ni_3(L^4)\ Cl_6]$ compound in cathodic and anodic potential, correspondingly. Controlled potential electrolysis (CPE) was also conducted and the experiment revealed that every pair correlated to one-electron transfer process (OET) as mentioned below:

$$Ni^{II}Ni^{II}Ni^{II} \rightarrow Ni^{II}Ni^{II}Ni^{I} \rightarrow Ni^{II}Ni^{I}Ni^{I} \rightarrow Ni^{I}Ni^{I}Ni^{I}$$

The nickel (II) compound got at positive potential region emerged one electron transfer (OET) waves. The oxidation process was also quasi reversible in nature. The oxidation process is allocated as follows:

$$Ni^{II}Ni^{II}Ni^{II} \rightarrow Ni^{II}Ni^{II}Ni^{III} \rightarrow Ni^{II}Ni^{III}Ni^{III} \rightarrow Ni^{III}Ni^{III}Ni^{III}$$

The $[Mn_3(L^4)\ Cl_6]$ compound appeared three reduction waves. The first, second and third reduction potential of the compound $E^1_{pc} = -1.63$V, $E^2_{pc} = -1.10$ V, $E^3_{pc} = -0.57$ V are assigned to reduction of Mn (II). The ΔEp results implied the presence of a quasi-reversible couple. The $E_{1/2}$ result specified that every pair correlated to one electron transfer (OET) process. Controlled potential electrolysis (CPE) was also conducted and the experiment reported that every pair corresponded to one-electron transfer (OET) process, as mentioned below:

$$Mn^{III}Mn^{III}Mn^{III} \rightarrow Mn^{III}Mn^{III}Mn^{II} \rightarrow Mn^{III}Mn^{II}Mn^{II} \rightarrow Mn^{II}Mn^{II}Mn^{II}$$

n manganese (II) compound, oxidation peak at the positive potential side specified that the process occured on the metal centre. This explained a one-electron oxidation of manganese (II)/ manganese (III) [14-16].

Table 3: The UV spectra of the compounds

Compounds	π-π* (nm)	n-π* (nm)	L-M CT (nm)	d-d (nm)
$[Cu_3C_{70}H_{60}N_{12}O_4Cl_6]$	276	325	412	512,675
$[Ni_3C_{70}H_{60}N_{12}O_4Cl_6]$	282	328	410	548,615&711
$[Mn_3C_{70}H_{60}N_{12}O_4Cl_6]$	287	312	382	588,621&698
$[Zn_3C_{70}H_{60}N_{12}O_4Cl_6]$	289	330	370	
$[Cr_3C_{70}H_{60}N_{12}O_4Cl_6]$	292	334	368	

Table 4: Electrochemical results of homo and hetero trinuclear compounds (reduction)

Compounds	E_{pc} (V)	E_{pa} (V)	$E_{1/2}$ (V)
$[Cu_3(L^4)\ Cl_6]$	−1.70 −1.17 −0.29	−1.41 −1.05 −0.24	−1.56 −1.11 −0.27
$[Ni_3(L^4)\ Cl_6]$	−1.85 −1.56 −1.17	−1.77 −1.48 −0.94	−1.81 −1.52 −1.06
$[Mn_3(L^4)\ Cl_6]$	−1.63 −1.10 −0.57	−1.42 −0.93 −0.38	−1.53 −1.02 −0.48

Table 5: Electrochemical data of homo and hetero trinuclear compounds (oxidation)

Compounds	E_{pc} (V)	E_{pa} (V)	$E_{1/2}$ (V)
$[Cu_3(L^4)\ Cl_6]$	0.33 0.59 0.87	0.47 0.74 0.95	0.40 0.67 0.91
$[Ni_3(L^4)\ Cl_6]$	0.37 0.61 0.86	0.51 0.69 1.04	0.44 0.65 0.95
$[Mn_3(L^4)\ Cl_6]$	0.27 0.61 0.87	0.43 0.74 0.87	0.35 0.68 0.91

Electron paramagnetic resonance spectra (EPR)

The ESR spectra of the trinuclear compounds $[Cu_3(L^4)Cl_6]$ and $[Mn_3(L^4)Cl_6]$ recorded at room temperature and compounds were anisotropic. The results of two compounds were $g_{iso} = 2.0068$ and 2.0049.

The spectrum of the $[Cu_3(L^4)\ Cl_6]$ compound appeared a broad signal and there is no splitting. The compound had g_{iso} at 2.0068. It was compatible with a distorted octahedral geometry. Dipolar interactions caused the broadening of this signal and suggesting exchange interaction present in the trinuclear compound. The increased broadness of resonance line at higher magnetic field confirmed presence of excess of copper ion. Similarly, trinuclear $[Mn_3(L^4)\ Cl_6]$ produced a single unresolved signal and signified an exchange interaction between the Mn (II) centres. Octahedral environment was confirmed and g_{iso} value was 2.0049. Therefore, coordination between ligand groups and the metal ion in an octahedral environment was confirmed by these spectra [17,18].

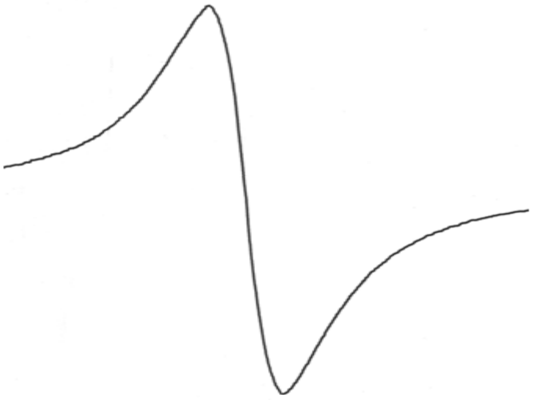


Fig 1: EPR spectra of $[Cu_3(L^4)\ Cl_6]$ complex

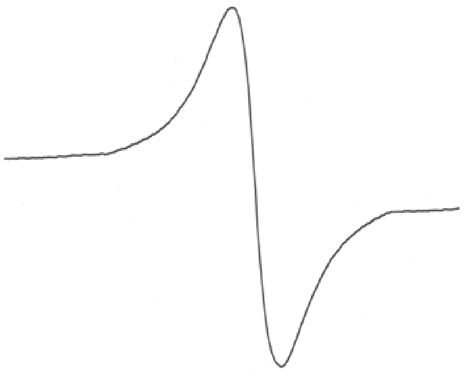


Fig 2: EPR spectra of [Mn3(L4) Cl6] complex

Magnetic measurements

The Bohr magneton values of the compounds were calculated. The paramagnetic nature and the +2 oxidation state of Cu (II) compound were confirmed by magnetic susceptibility. The strong antiferro magnetic coupling was main reason for the lower value of trinuclear Cu(II) compound (1.58 B.M) compared with calculated Bohr magneton value of mononuclear Cu(II) compounds (1.68 B.M). Therefore, it is noted that one more copper metal was present in coordination entity.

In the same way, the Bohr magneton value of trinuclear Ni (II) compound representing an octahedral geometry having two unpaired electrons was lower i.e. 2.68 B.M than mononuclear nickel (II) compound. This indicated that one more metal ion present in coordination sphere.

At the room temperature, Bohr magneton value of trinuclear Mn (II) compound representing an octahedral geometry was lower i.e. 5.63 B.M compared with spin only magnetic moment for mononuclear manganese compound. Therefore, it specified that one more metal ion present in coordination sphere [19,20].

Thermal analysis

The thermal decomposition of the compounds was studied in this work Thermogravimetric (TG) analysis for the compounds were conducted at 0-900°C. The weight loss of compounds was determined and compared for expelled groups. The estimated loss of weight for all complexes was approximately equal to calculated values.

In the TG curve of $[Cu_3(L^4)\ Cl_6]$ compound having the molecular formula $[Cu_3C_{70}H_{60}N_{12}O_4Cl_6]$, decomposition carried out in three successive steps between 180-680°C. Theoretical values were in good agreement with experimental value. It was noted that the first weight loss commenced at 180–360°C with an estimated loss of mass 13.84% (calculated loss of mass = 14.56) and this was because of loss of six Cl groups. The second step arose at 360–470°C with an estimated loss of mass 19.81% (calculated loss of mass =20.26%) and this was logically counted for the loss of aromatic groups. The third step arose at 470–680°C with an estimated loss of mass 37.79% (calculated loss of mass =38.86%) and it was logically counted for the loss of coumarin groups. The estimated total loss of mass was 71.44% (calculated total loss of mass = 72.24%).

The $[Ni_3(L^4)\ Cl_6]$ compound with the molecular formula $[Ni_3C_{70}H_{60}N_{12}O_4Cl_6]$ decomposed at 150-500°C. In keeping with the TG curves, the decomposition took place more than one step. The first step started between 150–370°C with an estimated loss of mass 33.97% (calculated loss of mass = 34.56) and it was because of loss of six Cl groups and aromatic groups. The second step commenced at 370–500°C with an estimated loss of mass 38.15% (calculated loss of mass = 39.71%), which was logically counted for the loss of coumarin groups. The estimated total loss of mass was 72.13% (calculated total loss of mass = 71.18%). Both values were approximately equal.

The $[Mn_3(L^4)\ Cl_6]$ compound with the molecular formula $[Mn_3C_{70}H_{60}N_{12}O_4Cl_6]$ decomposed at 175-650°C. The estimated total loss of mass was 72.66% (calculated total loss of mass = 71.83%) between 175-650°C °C may be ascribed to the removal of the six Cl groups, aromatic ligand groups and coumarin groups. Theoretical and experimental values were in good agreement.

The $[Zn_3(L^4)\ Cl_6]$ compound with the molecular formula $[Zn_3C_{70}H_{60}N_{12}O_4Cl_6]$ decomposed at 160-550°C. The first step happened at 160–400°C with an estimated loss of mass 13.79% (calculated loss of mass = 14.56) and it was because of loss of six Cl groups. The second step arose at 400–550°C with an estimated loss of mass 19.74% (calculated loss of mass = 18.99%) and this was logically counted for the loss of aromatic groups.

The $[Cr_3(L^4)\ Cl_6]$ compound with the molecular formula $[Cr_3C_{70}H_{60}N_{12}O_4Cl_6]$ decomposed between 200-500°C. The first step commenced at 200–350°C with an estimated loss of mass 14.16% (calculated loss of mass = 13.56) and it was because of loss of six Cl groups. The second step arose at 350–500°C with an estimated loss of mass 20.27% (calculated loss of mass = 19.66%) and it was logically counted for the loss of aromatic groups [21,22].

Table 6: Thermo analytical data of the homo and hetero trinuclear complexes

Compounds	TG range (ºC)	Estimated (Calculated) (%)		Assignment	Metallic residue
		Loss of mass	Total loss of mass		
$[Cu_3(L^4)Cl_6]$	180-360 360-470 470-680	13.84 (14.56) 19.81 (20.26) 37.79 (38.86)	71.44 (72.24)	Loss of six Cl groups, aromatic groups and coumarin groups.	Decomposition is in progress
$[Ni_3(L^4)Cl_6]$	150-370 370-500	33.97 (34.56) 38.15 (39.71)	72.13 (71.18)	Loss of six Cl groups, aromatic groups and coumarin groups.	Decomposition is in progress
$[Mn_3(L^4)Cl_6]$	175-650	72.66 (71.83)	72.66 (71.83)	Loss of six Cl groups, aromatic groups and coumarin groups.	Decomposition is in progress
$[Zn_3 (L^4)Cl_6]$	160-400 400-550	13.79 (14.56) 19.74 (18.99) -	-	Loss of six Cl groups, aromatic groups.	Decomposition is in progress
$[Cr_3 (L^4)Cl_6]$	200-350 350-500	14.16 (13.56) 20.27 (19.66) -	-	Loss of six Cl groups, aromatic groups .	Decomposition is in progress

Deoxyribonucleic acid (DNA) cleavage study

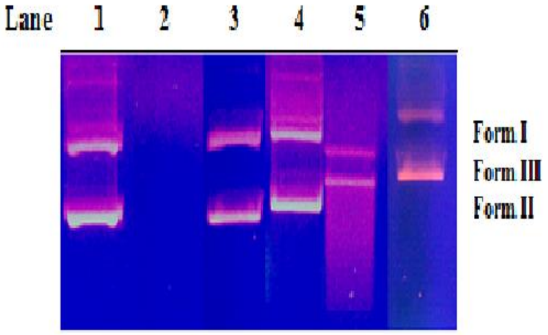


Fig 3: Gel electrophoretic model of Schiff base compounds.

Lane 1, pUC18DNA alone.
Lane 2, pUC18DNA +Cu compound + H_2O_2,
Lane 3, pUC18DNA +Zn compound+ H_2O_2,
Lane 4, pUC18DNA +Cr compound+ H_2O_2,
Lane 5, pUC18DNA +Ni compound + H_2O_2 and
Lane 6, pUC18DNA +Mn compound + H_2O_2,

This study was analysed by the Gel electrophoresis process. While electrophoresis was processed, movement of super coiled (SC) form was speedy and it was called as Form I. When one strand was cleaved, super coil (SC) form was converted to open circular (OC) form and it was known as Form-II. Form III meant a linear form was moved and existed between forms-I and II while both strands were cleaved. There was significant importance in DNA cleavage study that was enhanced by Schiff base compounds. One of the mainly remarkable electrophoretic data of the compounds was noted when test carried out with hydrogen peroxide. The Schiff base compound containing hydrogen peroxide systems cleaved DNA. Thus, we confirmed that the combination of compounds with H_2O_2 was found to be efficient oxidant. There was no cleavage of DNA happened for ligand although elongated coverage time (lane1). The copper, nickel and manganese compounds (lane 2,5&6) have got more efficiency compared with other metal complexes. Zinc and chromium compounds were shown moderate effectiveness (Lane 3&4) [23,24].

In vitro Antimicrobial studies

Due to the various biological roles shown by Cu(II), Ni(II), Mn(II), Zn(II) and Cr(III) metal ions, efforts were being made to prepare Schiff base transition trinuclear metal complexes to know their structure, spectral, and electrochemical properties. The prepared compounds were analysed for their antimicrobial action against bacteria *Staphylococcus aureus, Escherichia coli and Klebsiella pneumoniae*. After sterilizing Petri dishes in autoclave, disc diffusion method was conducted inside air purifier. Antibiotic sensitivity of bacteria is tested by this method. The stock solution was arranged by mixing the compound in dimethyl formamide and the solution was diluted to find result. The swab was kept for the broth culture of microbes and streaked the agar plate to create lawn for bacteria by using swab in Petri dishes. The plates are kept undisturbed and dried for 5 minutes. The optimum pH level of the agar is between 7.2 and 7.4. Glass plates were kept inside the incubator for 24 hours at 35°C.The streptomycin was used as standard. After measuring database, diameter of the given sample is compared with standard value to know microbes susceptible, moderately susceptible or resistant to the antibiotic. If metal complex prevented the bacterial growth, the region where bacteria was not grown, could be visible, it was known as zone of inhibition. The results are given in Table 7. It was confirmed that Schiff base compound had got more efficiency. The Cu(II),Ni(II) compounds showed a higher antibacterial action. The action of Mn(II) complex was moderate. Zn(II) and Cr(III) compounds showed activity. The result of antimicrobial action showed that all of the prepared compounds exhibited different antimicrobial action [25-27].

Table 7: Antibacterial activity of the compounds

Compounds	K.pneumonia (mm)				E.coli (mm)				S.aureus(mm)			
	Concn. (µg/ml)											
	25	50	75	100	25	50	75	100	25	50	75	100
[$Cu_3C_{70}H_{60}N_{12}O_4Cl_6$]	12	14	17	19	13	13	17	18	12	14	17	19
[$Ni_3C_{70}H_{60}N_{12}O_4Cl_6$]	11	13	16	18	12	15	15	17	12	12	18	18
[$Mn_3C_{70}H_{60}N_{12}O_4Cl_6$]	11	13	15	16	13	14	14	17	12	14	16	17
[$Zn_3C_{70}H_{60}N_{12}O_4Cl_6$]	10	11	11	15	11	12	12	16	12	12	13	14
[$Cr_3C_{70}H_{60}N_{12}O_4Cl_6$]	10	10	11	14	12	12	13	14	11	12	13	13

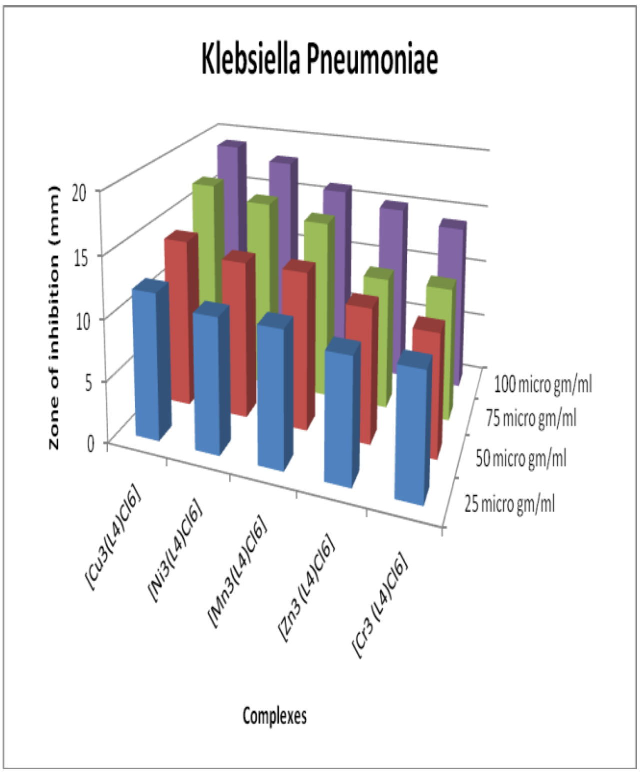


Fig 4: Deviation among the antimicrobial action of the compounds against Klebsiella pneumoniae

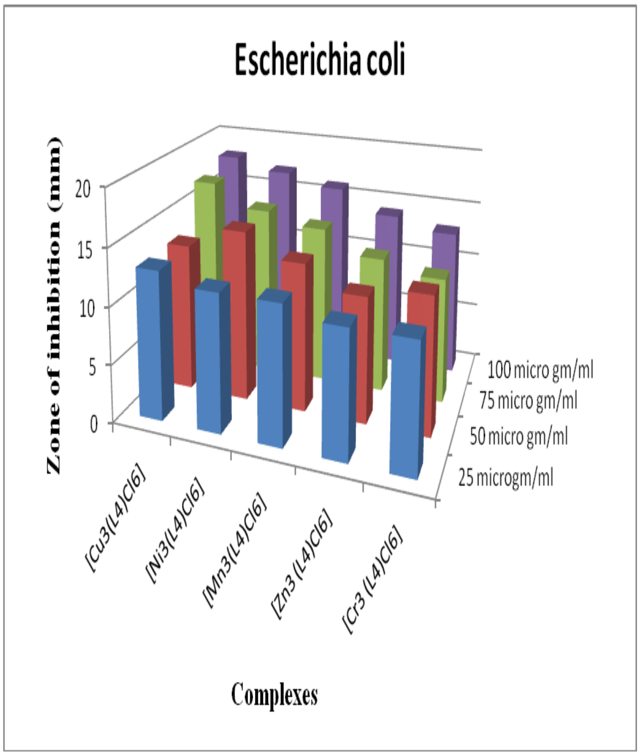


Fig 5: Deviation among the antimicrobial action of the compounds against Escherichia coli

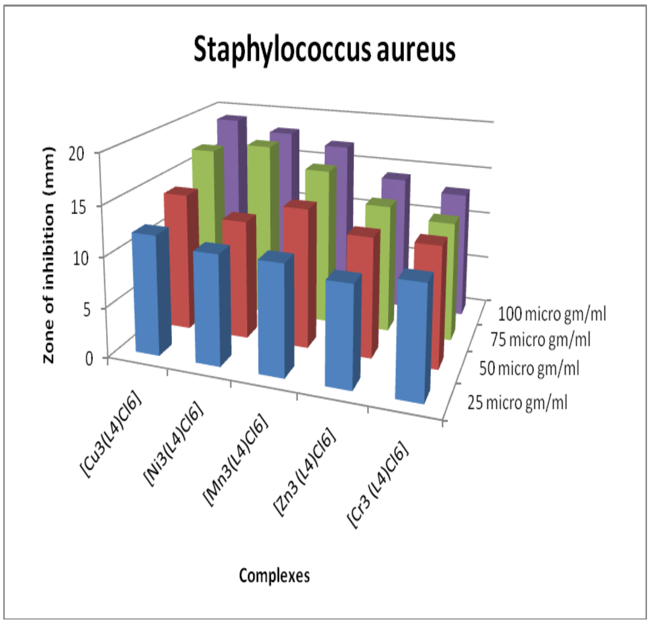


Fig 6: Deviation among the antimicrobial action of the compounds against Staphylococcus

IV. CONCLUSION

The Cu (II), Ni (II), Mn (II), Zn (II) and Cr (III) compounds were prepared from p-phenylene diamine, 2,3-pentane dione and 3-amino coumarin. The metal (II) and (III) Schiff base complexes were characterised by physico chemical method and spectral methods such as IR and UV, CV and EPR. The spectral data revealed that complexes are octahedral. Non electrolytic nature was concluded by the molar conductance measurements. We have completed DNA cleavage study.
The prepared Cu and Ni compounds showed more effectiveness towards DNA cleavage action with hydrogen peroxide. We have also evaluated the antibacterial activity of Schiff base compounds and Cu and Ni compounds had more potential towards antimicrobial action.

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