Synthesis, Characterization and Antimicrobial Studies of Transition Metal Complexes of Schiff Base derived from Salicylaldehyde and L-Tyrosine Amino Acid

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ABSTRACT

Biologically active tridentate Schiff base Salicylidene-tyrosine (H_2L) derived from salicyaldehyde and L-tyrosine and their Mn(II), Fe(II), Co.(II), Cu(II) and Ni(II) complexes have been prepared in 1:1 stochiometric ratio and characterised on the basis of their solubility , metal analysis, infrared, UV-Visible and magnetic measurements. The synthesised complexes have varying shades of colour and decomposed at a temperature above 360^oC. Salicylidene-tyrosine acts a tridentate ligand coordinating to the metals through the azomethine nitrogen atom, the oxygen atom of hydroxyl group of COOH and the phenolic oxygen to give an octahedral geometry. The electronic spectra are in consistent with the proposed octahedral geometry around the metal ions. The metal complexes were screened for their antimicrobial activities against Staphylococcus aureus (ATCC 12600), Escherichia.coli (ATCC 8739), Pseudomonas aeruginosa (ATCC 10145), Bacillus subtilis (ATCC 39090), Salmonella typhi(ATCC 6539), Klebsiella pneumonia (ATCC 35657), Candida albicans (ATCC 10231), Penicillium notatum (ATCC 20269), Rhizopus stolonifer (ATCC 14037) and Aspergillus niger (ATCC 16888). The copper complex $[Cu(L)(H_2O)_3].H_2O$ exhibited the greatest activity in all the organisms tested It is active against all microorganisms tested at virtually all concentrations.

Keywords: Antimicrobial, Salicyladehyde, L-tyrosine, Schiff base,

INTRODUCTION

Schiff bases have been used as organic chelating ligands in the synthesis of diverse transition metal complexes[1,2]. The Schiff bases derived from the reaction of aldehyde or ketone with amino acid are an excellence class of ligands which have a variety of applications including biological, clinical, industrial, analytical, as well as catalysis and organic synthesis[3-5]. Amino acid Schiff base complexes are an area of increasing attention, it has been reported that they possess anticarcinogenic, antimicrobial and antitumor activity[6-8]. Aromatic amino acids are essential to higher animals including humans. L-tyrosine an aromatic aminoacids is a hydroxylated derivative of L-phenyl alanine. The body needs the essential amino acid L-phenylalanine (and L-tyrosine) to make melanine, dopamine, noradrenaline, adrenaline and thyroxine. A shortage of either of these two aromatic amino acids could cause mental disorders, including anxiety, depression, low libido, and chronic fatigue[9]. Schiff bases containing L-tyrosine and their metal complexes exhibit a variety of interesting properties[10].

From Literature antimicrobial activity against gram-positive and gram negative bacteria was reported for Schiff bases containing indole-3-carboxaldehyde and their transition metal (Cu, Ni, Co) complexes[11,12]. A mononuclear copper(II) complex with a Schiff base derived from 5-bromosalicylaldehyde and L-tyrosine mimics ascorbate oxidase activity[13]. Catalytic activity was reported for ruthenium(II) complexes with substituted Salicyladehyde[14]. Here, we report a Schiff base (Fig. 1) formed from the reaction of salicylaldehyde and L-tyrosine amino acid, their coordination complexes, and their antimicrobial studies.

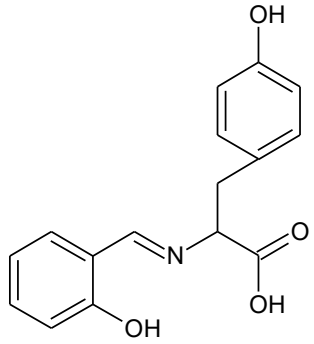


Figure 1: Salicylidene-tyrosine Schiff base (H_2L)

MATERIALS AND METHODS

Materials and Reagents.

All reagents and solvents were of analytical grade and used without further purification. L-tyrosine, Salicylaldehyde, Cobalt (II) Chloride hexahydrate, Copper (II) Chloride dihydrate, Manganese (II) Sulphate tetrahydrate, Iron (II) sulphate heptahydrate and Nickel (II) acetate hexahydrate were obtained from Aldrich chemicals.

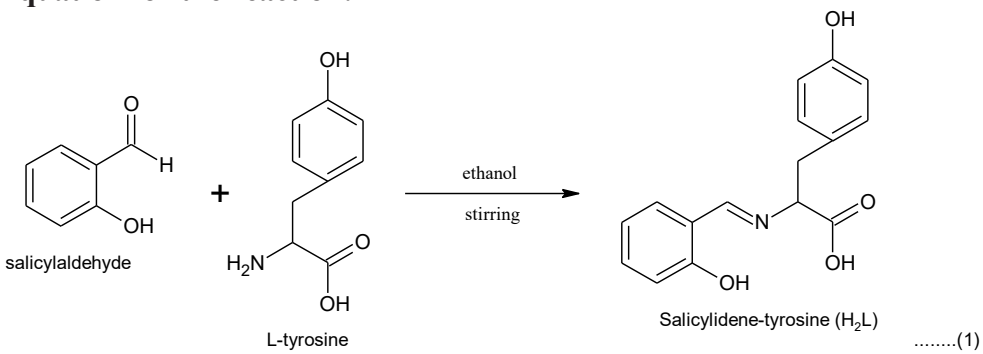
Physical measurements

The electronic spectra of the complexes in DMSO were recorded on a Perkin-Elmer Lambda 25 Spectrophotometer and infrared spectra were recorded using nujol on a Perkin-Elmer BX II FT-IR spectrometer 4000–370 cm^{-1}. The room temperature magnetic susceptibilities at 303K were measured on Sherwood Susceptibility Balance MSB Mark 1 and diamagnetic corrections were calculated using Pascal's constant, and melting points were determined with Stuart SMP10 Melting point apparatus.

Synthesis of Salicylidene-L-tyrosine Schiff base (H_2L)

The Schiff base (H_2L) was synthesised according to the published procedure[15] with slight modification. (2.44g, 0.02mol) of salicylaldehyde in 15ml ethanol was added in drops to a stirring mixture of (3.624g, 0.02mol) tyrosine and (0.8g, 0.02mol) sodium hydroxide in 15ml ethanol. The resulting mixture was stirred at 110^{o}C for 2hours and the resulting solution was evaporated under vacuum to remove the solvent. The product was collected by filtration, washed several times with ethanol and recrystallized from hot ethanol and dried in a vacuum desiccator. The melting point of the resulting deep brown coloured schiff base was found to be 307°C with 75 % yields.

Equation for the reaction:



.....(1)

Synthesis of complexes [ML(H$_2$O)$_3$].H$_2$O where M= Ni, Cu, Co, Fe, Mn

A mixture of the schiff base (0.02mol) in 15 ml ethanol and the same amount of the same solvent of metal salt (0.01mol) (MX_2, where M=Ni (II), Co (II), Cu (II) and Mn(II) ; X=Cl/NO_3 /acetates) were refluxed for two hours at 70-80°C on water bath . On cooling, colored solid product was collected by filtration and then washed several times with hot ethanol until the washing becomes colourless. The product was dried in air and stored in a desiccator over anhydrous $CaCl_2$. All the metal complexes are coloured and stable to air and moisture.

Antimicrobial susceptibility test

Antibacterial and antifungal activities of the ligands and their complexes were tested in vitro using Agar diffusion method. The prepared culture plates were inoculated with different identified laboratory strains of bacteria and fungi such as: *Staphylococcus aureus* (ATCC 12600), *Escherichia.coli* (ATCC 8739), *Pseudomonas aeruginosa (*ATCC 10145), *Bacillus subtilis* (ATCC 39090), *Salmonella typhi* (ATCC 6539), *Klebsiella pneumonia* (ATCC 35657), *Candida albicans* (ATCC 10231), *Penicillium notatum* (ATCC 20269), *Rhizopus stolonifer* (ATCC 14037) *and Aspergillus niger* (ATCC 16888) using streak plate method. Wells were made on the agar surface with 6mm sterile cork borer. The prepared different gradient concentrations of the complexes and the ligand were poured into the well using sterile syringe. The plates were incubated at 37 ºC ± 2 ºC for 24 hours for bacterial and 25 ± 2 ºC for 48hours for fungal activity. The plates were observed for the zone clearance around the wells. The zone of inhibition was calculated by measuring the diameter of the inhibition zone around the well (in mm) including the well diameter. The experiments were conducted in triplicates with Gentamycin and Tioconazole being used as the reference drug (positive control) for the bacteria and fungi acitvities respectively.

RESULTS AND DISCUSSION

The condensation of salicyaldehyde and L-tyrosine aminoacids has yielded salicylidene-tyrosine Schiff base (H_2L) as given in equation1 above. Complexes obtained from the reaction of salicylidenetyrosine Schiff base with metal

(II) salt of Mn, Cu, Co, Fe and Ni are stable at room temperature exhibiting variety of colours with good yields as shown in Table1. The complexes decompose on melting at temperature above 360^{o}C, and are soluble mainly soluble in DMSO but slightly soluble in water. The analytical data are summarized in Table1 below. and also decompose on melting at temperature above 360^{o}C.

Table 1:- Analytical data for the complexes

Compound	Mol.Wt (g/mol)	Colour	% Yield	M.Pt (^{0}C)	%Metal Exp (Calc)	μ_{eff} (BM)
H_2L	285	Dark brown	78	307	_	_
$[Fe(L)(H_2O)_3].H_2O$	411	Brown	80	>360	13.70 (13.62)	5.1
$[Mn(L)(H_2O)_3].3H_2O$	448	Brown	71	>360	12.20 (12.26)	2.79
$[Co(L)(H_2O)_3]$	398	Black	68	>360	14.69 (14.80)	4.05
$[Ni(L)(H_2O)_3].3H_2O$	398	Deep green	76	>360	14.68 (14.74)	3.28
$[Cu(L)(H_2O)_3].H_2O$	454.5	Grey	81	>360	13.63 (13.97)	1.98

Infra red spectra studies of synthesized compounds

In order to clarify the mode of bonding and the effect of the metal ion on the ligand, the IR spectra of the Schiff base, and the metal complexes were studied and assigned based on careful comparison of their spectra. The IR data is presented in Table 2. All the complexes exhibit broad bands in the range of 3352–3552 cm^{-1}, which can be attributed to the presence of coordinated water molecules[16]. A band at 1633 cm^{-1} in free salicylidene-tyrosine ligand (H_2L) is due to √C=N vibration. The shifting of this band to lower frequency (1632-1599 cm^{-1}) in the metal complexes suggests the coordination of metal ion through nitrogen atom of azomethine group, as metal atom would reduce the electron density in the azomethine link and thus lower the HC=N absorption[15]. The involvement of oxygen atom of hydroxyl group of COOH group in bonding with metal ions was evident from the difference of maxima positions as observed for $\sqrt{}_{asy}$(COO) and $\sqrt{}_{sym}$(COO) at 1530 and 1515cm^{-1} in H_2L but were shifted to lower frequency 1514-1456cm^{-1} and 1455-1357cm^{-1} in the metal complexes[15,17].

The √(Ph-O) (Phenolic) stretching frequency observed at 1277cm^{-1} in the ligand, was shifted to a lower frequency region in the complexes in the range of 1202-1138cm^{-1}, this is indicative of bonding through phenolic oxygen[18]. In addition, the new bands at about 607-532 cm^{-1} and 525-460 cm^{-1} are assigned to M-N and M-O vibrations, respectively which support the involvement of N and O atoms in complexation with metal ions under investigation[19].

Table 2: IR data of salicylidene-tyrosine ligands and the complexes

Compounds	$\sqrt{}_{(O-H)/H2O}$	$\sqrt{}_{C-H(aliphatic)}$	$\sqrt{}_{C=N}$	$\sqrt{}_{COO(asy)}$	$\sqrt{}_{COO(sym)}$	$\sqrt{}_{Ph-O}$	$\sqrt{}_{M-N}$	$\sqrt{}_{M-O}$
H_2L	_	_	1633,	1530	1515	1277	_	_
$[Fe(L)(H_2O)_3].H_2O$	3368(b)	2924, 2854	1619	1461	1376	1158	607	460
$[Mn(L)(H_2O)_3].3H_2O$	3386(b)	2928	1632	1461	1376	1138	605	525
$[Co(L)(H_2O)_3]$	3552, 3392	2923, 2853	1599	1514	1455	1151	541	492
$[Ni(L)(H_2O)_3].3H_2O$	3356	2923, 2853	1605	1456	1357	1155	532	503
$[Cu(L)(H_2O)_3].H_2O$	3444	2923, 2853	1613	1514	1450	1202	538	492

H_2L= Salicylidene-L-tyrosine Schiff base

Electronic spectra of synthesized compounds

The electronic spectral absorptions of the ligand and complexes are presented in Table 3. The

Intraligand absorptions at 38766, 31265 and 26100cm^{-1} were assigned to π→ π*, π→π* and

n→ π*. The Fe complex showed d-d bands at 16313 and 12048cm^{-1} which were assigned to $^5T_{2g} \rightarrow {}^5B_{1g}$, $^5T_{2g} \rightarrow {}^5A_{1g}$ respectively typical of high spin d^6 configuration with magnetic moment of 5.1, the remaining bands at 45249, 29586 and 26455cm^{-1} were assigned to charge transfer and π-π* bands respectively. The Co(II) complex exhibited well-resolved, bands at 23923,19646 and 17094 cm^{-1} assigned[35] to the transitions $^4T_{1g}(F) \rightarrow {}^4T_{2g}(P)$, $^4T_{1g}(F) \rightarrow {}^4A_{2g}(F)$ and $^4T_1g(F) \rightarrow {}^4T_{2g}(F)$ for a high-spin octahedral geometry[20-21] . A high intensity band at 45,045cm^{-1} was assigned to metal to ligand charge transfer (Table 3). The magnetic susceptibility measurements (4.05 B.M) for the solid Co(II) complex is also indicative[22] of three unpaired electrons per Co(II) ion suggesting[23] consistency with their octahedral environment (Figure 2). The electronic spectra of the Cu(II) complexes (Table 3) showed low energy bands at 17212cm^{-1} attributed to $^2Eg \rightarrow {}^2T_{2g}$ transition[24]. The low-energy band in this position is expected for an octahedral configuration[25] and strong high energy bands at 39525 and 45045 cm^{-1} assigned to π→π* and metal to ligand charge transfer transitions. Also, the magnetic moment values 1.98 BM are indicative of antiferromagnetic spin-spin interaction through molecular association. Hence, the Cu(II) complexes appear to be in the octahedral geometry[26].

Ni(II) complexes showed d-d bands in the regions, 11494, 12516, and 13698 cm^{-1}. These are assigned to the spin-allowed transitions $^3A_{2g}$ (F) → $^3T_{2g}$ (F); $^3A_{2g}$ (F) → $^3T_{1g}$ (F) and $^3A_{2g}$ (F) → $^3T_{1g}$ (P) respectively, consistent with their well-defined octahedral configuration. The band at 26041cm^{-1} was assigned to n→ π* and 36232cm^{-1} was assigned to metal → ligand charge transfer. The magnetic measurements (3.28 B.M) showed two unpaired electrons per Ni(II) ion suggesting [22] also an octahedral geometry for the Ni(II) complexes[27].

The electronic spectrum of the manganese(II) complex shows very weak absorptions in the visible region at 16447, 13186 and 12484 cm^{-1} and these were

assigned to $^6A_{1g} \rightarrow {}^4T_{2g}$; $^6A_{1g} \rightarrow {}^4T_{1g}$ and $^6A_{1g}$ (F) $\rightarrow {}^4E_g$ which were spin forbidden transitions. The bands at 44642cm ^{1}, 31055cm^{-1} and 26176cm^{-1} were attributed to charge transfer, $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ respectively. The observed magnetic moment for Mn(II) complex was 2.79 B.M which is approximately half of the expected range (5.7-6.0 B.M) for a high spin Mn(II) complex. On this basis, the Mn(II) complex was suggested to be dimeric

Table 3: Electronic spectra data for salicylidene-tyrosine ligand (H_2L) and its metal(II) complexes.

compound	UV bands (cm^{-1})	Probable transitions
H_2L	38,766	$\pi \rightarrow \pi^*$
	31265	$\pi \rightarrow \pi^*$
	26100	$n \rightarrow \pi^*$
$[Fe(L)(H_2O)_3].H_2O$	45249	CT
	29586	$\pi \rightarrow \pi^*$
	26455	$n \rightarrow \pi^*$
	16313	$^5T_{2g} \rightarrow {}^5B_{1g}$
	12048	$^5T_{2g} \rightarrow {}^5A_{1g}$
$[Mn(L)(H_2O)_3].3H_2O$	44642	CT
	31055	$\pi \rightarrow \pi^*$
	26178	$n \rightarrow \pi^*$
	16447	$^6A_{1g} \rightarrow {}^4T_{2g}$
	13186	$^6A_{1g} \rightarrow {}^4T_{1g}$
	12484.	$^6A_{1g} \rightarrow {}^4E_g$
$[Co(L)(H_2O)_3]$	45045	CT
	30395	$\pi \rightarrow \pi^*$
	26178	$n \rightarrow \pi^*$
	23923	$^4T_{1g}(F) \rightarrow {}^4T_{2g}(P)$
	19646	$^4T_{1g}(F) \rightarrow {}^4A_{2g}(F)$
	17094	$^4T_{1g}(F) \rightarrow {}^4T_{2g}(F)$
$[Ni(L)(H_2O)_3].3H_2O$	36232	CT
	26041	$n \rightarrow \pi^*$.
	13698	$^3A_{2g}(F) \rightarrow {}^3T_{2g}(P)$
	12516	$^3A_{2g}(F) \rightarrow {}^3T_{1g}(F)$
	11494.	$^3A_{2g}(F) \rightarrow {}^3T_{2g}(F)$
$[Cu(L)(H_2O)_3].H_2O$	45045	CT
	39525	$\pi \rightarrow \pi^*$
	17212	$^2E_g \rightarrow {}^2T_{2g}$

H_2L= Salicylidene-L-Htyrosine Schiff base

Figure 3: Proposed structure of metal(II) complexes of Salicylidene-L-tyrosine Schiff base

Antimicrobial studies

The metal complexes were screened for their antimicrobial activities against *Staphylococcus aureus* (ATCC 12600), *Escherichia.coli* (ATCC 8739), *Pseudomonas aeruginosa (*ATCC 10145), *Bacillus subtilis* (ATCC 39090), *Salmonella typhi* (ATCC 6539), *Klebsiella pneumonia* (ATCC 35657), *Candida albicans* (ATCC 10231), *Penicillium notatum* (ATCC 20269), *Rhizopus stolonifer* (ATCC 14037) *and Aspergillus niger* (ATCC 16888). The antimicrobial report is summarized on Table 4 and 5. The synthesised Schiff base saliyclidene-tyrosine shows some antibacterial and antifungal activities against some tested microbes used especially at higher concentrations. However, it shows no inhibition against *Salmonella typhi, Klebsiella pneumonae and Rhizophus stolonifer* at all concentrations. However, on coordination the ligand antimicrobial activities improved with all the complexes showing an improved level of inhibition against the microbes.

The copper complex $[Cu(L)(H_2O)_3].H_2O$ exhibited the greatest activity in all the organisms tested It is active against all microorganisms at virtually all concentrations. Ni complex also shows a remarkably significant level of activity against all the microbes. However, at the lowest concentration it was only active against *Staphylococcus aureus.* Of all the complexes, Fe complex $[Fe(L)(H_2O)_3].H_2O$ shows the lowest level of activity as it is not active against *Klebsiella pneumonae, Penicillium notatum* and *Rhizophus stolonifer* at all concentrations. However it shows a significant level of activity against other organism especially at high concentration.

Co complex $[Co(L)(H_2O)_3]$ was also not active against *Klebsiella pneumonae* and *Penicillium notatum* but also has a significant activity against other microbes especially at high concentrations. In general, the activities of the complexes and the ligand decreases as their concentrations decreases and none is as active as the control which were gentamycin (for bacteria) and Tioconazole (for bacteria). Further pharmacological investigation of these compounds should reveal their possible use in treatment of these bacterial and fungal infections.

Table 4: Antibacterial screening of metal(II) complexes of Salicylidene-L-tyrosine

Compound/Conc	S.a	E.c	B.s	P.a	S.t	K.p
H_2L 1000µg/ml	14±1.45	14±0.33	14±0.33	12±0.17	-	-
500µg/ml	10±0.22	12±0.33	12±0.52	10±0.19	-	-
250µg/ml	-	10±0.66	10±0.54	-	-	-
125µg/ml	-	-	-	-	-	-
62.5µg/ml	-	-	-	-	-	-
31.25 µg/ml	-	-	-	-	-	-
+C	40±0.00	38±0.00	38±0.00	40±0.00	38±0.00	40±0.00
-C	-	-	-	-	-	-
$[Fe(L)(H_2O)_3].H_2O$ 1000µg/ml	14±1.52	18±1.73	14±0.17	18±0.33	14±0.67	-
500µg/ml	12±0.67	16±1.12	12±0.67	16±1.15	12±0.23	-
250µg/ml	10±0.22	14±0.33	10±0.67	14±0.88	10±0.67	-
125µg/ml	-	12±1.97	-	12±1.13	-	-
62.5µg/ml	-	10±1.45	-	10±1.45	-	-
31.25 µg/ml	-	-	-	-	-	-
+C	40±0.00	38±0.00	38±0.00	40±0.00	38±0.00	40±0.00
-C	-	-	-	-	-	-
$[Mn(L)(H_2O)_3].3H_2O$ 1000µg/ml	18±2.30	18±0.33	18±1.12	16±0.33	14±1.54	14±1.12
500µg/ml	16±0.67	14±0.88	14±0.33	14±0.93	12±0.77	12±0.98
250µg/ml	14±1.18	12±0.23	12±1.75	12±1.12	10±0.33	10±0.67
125µg/ml	12±0.67	10±1.45	10±0.12	10±0.00	-	-
62.5µg/ml	10±0.67	-	-	-	-	-
31.25 µg/ml	-	-	-	-	-	-
+C	40±0.00	38±0.00	38±0.00	40±00	38±0.00	40±0.00
-C	-	-	-	-	-	-
$[Co(L)(H_2O)_3]$ 1000µg/ml	18±0.67	16±1.45	16±1.76	14±0.67	-	-
500µg/ml	14±0.32	14±0.23	14±0.33	12±0.67	-	-
250µg/ml	12±1.18	12±1.19	12±1.54	10±1.13	-	-
125µg/ml	10±0.67	10±0.77	10±0.93	-	-	-
62.5µg/ml	-	-	-	-	-	-
31.25 µg/ml	-	-	-	-	-	-
+C	40±0.00	38±0.00	38±0.00	40±0.00	38±0.00	40±0.00
-C	-	-	-	-	-	-
$[Ni(L)(H_2O)_3].3H_2O$ 1000µg/ml	24±0.57	20±2.02	20±0.73	18±0.13	18±1.77	16±0.45
500µg/ml	20±0.24	18±1.13	18±1.02	16±1.15	14±1.23	14±1.16
250µg/ml	18±0.33	14±0.55	14±1.45	14±0.67	12±0.37	12±0.99
125µg/ml	14±0.33	12±0.78	12±0.23	12±0.33	10±0.42	10±1.22
62.5µg/ml	12±1.73	10±0.54	10±0.78	10±0.94	-	-
31.25 µg/ml	10±0.57	-	-	-	-	-
+C	40±0.00	38±0.00	38±0.00	40±0.00	38±0.00	40±0.00
-C	-	-	-	-	-	-
$[Cu(L)(H_2O)_3].H_2O$ 1000µg/ml	28±1.45	26±0.67	24±0.78	24±0.19	20±0.33	18±0.77
500µg/ml	24±0.37	22±2.07	20±1.17	20±0.29	18±0.65	16±0.34
250µg/ml	20±1.17	20±1.27	18±0.22	18±0.66	16±0.66	14±1.22
125µg/ml	18±0.54	18±0.56	16±1.11	14±0.45	14±0.21	12±1.13
62.5µg/ml	14±0.67	14±0.36	14±0.13	12±0.67	12±0.55	10±0.67
31.25 µg/ml	12±0.45	10±0.25	10±0.77	10±0.65	10±0.34	-
+C	40±0.00	38±0.00	38±0.00	40±0.00	38±0.00	40±0.00
-C	-	-	-	-	-	-

Data are mean of three replicates (n = 3) ± standard error; ***-C= DMSO, +C = Gentamycin, S.a = Staphylococcus aureus, E.c = Escherichia coli, B.s = Bacillus subtilis, P.a = Pseudomonas aeruginosa, S.t = Salmonellae typhi, K.p = Klebsiella pneumonae***

Table 5: Antifungal screening of metal(II) complexes of Salicylidene-L-tyrosine

Compound/Conc	C.a	A.n	P.n	R.s
H_2L 1000µg/ml	16±0.17	14±0.33	12±0.66	-
500µg/ml	14±0.33	12±0.12	10±0.00	-
250µg/ml	12±0.66	10±0.57	-	-
125µg/ml	10±0.17	-	-	-
62.5µg/ml	-	-	-	-
31.25 µg/ml	-	-	-	-
+C	28±0.00	28±0.00	28±0.00	26±0.00
-C	-	-	-	-
$[Fe(L)(H_2O)_3].H_2O$, 1000µg/ml	14±0.29	10±0.00	-	-
500µg/ml	12±0.13	-	-	-
250µg/ml	10±0.33	-	-	-
125µg/ml	-	-	-	-
62.5µg/ml	-	-	-	-
31.25 µg/ml	-	-	-	-
+C	28±0.00	28±0.00	28±0.00	26±0.00
-C	-	-	-	-
$[Mn(L)(H_2O)_3].3H_2O$,1000µg/ml	16±0.57	14±1.52	14±0.67	14±0.22
500µg/ml	14±0.12	12±0.67	12±0.88	10±0.12
250µg/ml	12±0.32	10±0.97	10±1.15	-
125µg/ml	10±0.0	-	-	-
62.5µg/ml	-	-	-	-
31.25 µg/ml	-	-	-	-
+C	28±0.00	28±0.00	28±0.00	26±0.00
-C	-	-	-	-
$[Co(L)(H_2O)_3]$, 1000µg/ml	14±0.12	12±0.17	14±0.17	12±1.54
500µg/ml	12±0.57	10±0.57	12±1.63	10±0.88
250µg/ml	10±0.58	-	10±1.15	-
125µg/ml	-	-	-	-
62.5µg/ml	-	-	-	-
31.25 µg/ml	-	-	-	-
+C	28±0.00	28±0.00	28±0.00	26±0.00
-C	-	-	-	-
$[Ni(L)(H_2O)_3].3H_2O$,1000µg/ml	18±0.57	18±1.52	18±0.57	16±1.45
500µg/ml	16±1,20	14±0.88	16±1.03	14±1.11
250µg/ml	14±1,12	12±1.63	14±1.54	12±0.23
125µg/ml	10±1.17	10±1.20	10±0.67	10±1.12
62.5µg/ml	-	-	-	-
31.25 µg/ml	-	-	-	-
+C	28±0.00	28±0.00	28±0.00	26±0.00
-C	-	-	-	-
$[Cu(L)(H_2O)_3].H_2O$, 1000µg/ml	20±1.15	20±1.63	18±2.33	18±2.96
500µg/ml	18±1.45	18±0.47	16±1.77	16±0.66
250µg/ml	14±0.33	16±0.22	14±1.63	14±0.22
125µg/ml	12±1.13	14±1.15	12±0.67	12±1.19
62.5µg/ml	10±0.17	12±0.19	10±1.12	10±0.67
31.25 µg/ml	-	10±0.67	-	-
+C	28±0.00	28±0.00	28±0.00	26±0.00
-C	-	-	-	-

Data are mean of three replicates (n = 3) ± standard error; *-C= DMSO, +C = Tioconazole, C.a= Candida albicans* , *A.n= Aspergillus niger, P.n= Penicillium notatum, R .s= Rhizophus stolonifer*

CONCLUSION

The Schiff base salicylidene-tyrosine have been synthesised from the reaction of L-tyrosine and salicyaldehyde. The salicylidene-tyrosine metal (II) ions of Copper, Cobalt, Nickel, iron and manganese prepared have characterized by the spectroscopic methods. From the analytical and spectral data the salicylidene-tyrosine ligand acts as a tridentate ligand and was found to coordinate to the metal ions through the azomethine nitrogen atom, the oxygen atom of hydroxyl group of COOH and phenolic oxygen to give an octahedral geometry. Antimicrobial screening of the complexes showed that $[Cu(L)(H_2O)_3].H_2O$ is the most active of the complexes against all the tested microorganisms at all concentrations.

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