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A Study of New Schiff Bases Its Various Uses and Corresponding Metal Complexes

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ABSTRACT
A number of metal(II) complexes have been made from the Azo Schiff base ligand, where M = VO(II), Co(II), Ni(II), Cu(II), and Zn(II) (NE) -N-(5-((4-chlorophenyl)diazenyl)-2-hydroxybenzylidene)-2-hydroxybenzohydrazide)-2-hydroxybenzohydrazide. Conductivity investigations indicate that the complexes are not electrolytes. According to spectroscopic and other analytical research, certain complexes have tetrahedral geometry, while others have distorted square planar geometry for copper, square-pyramidal geometry for oxovanadium, and other complexes. The redox behaviour of the copper (II) complex has been investigated using cyclic voltammetry, and the biological activities of the ligand and metal complexes against diverse bacteria have been investigated using the well diffusion method. All synthesised materials have a chance to be photoactive based on their particular fluorescence properties. The second harmonic generation (SHG) efficiency of the ligand was found to be higher than that of urea and KDP. The particles seem to be 50 nm in size in the copper (II) complex SEM image.

I. INTRODUCTION

The imine group (-RC=N-) is present in the Schiff base. Hugo Schiff (1964) developed simple procedures for preparing and synthesising complexes using practically all bases. In recent years, numerous reports condensation of aldehyde- or ketone-like compounds (RCOR′) have been published on their biological activities, such as antibacterial, where R, R′ is either an alkyl or aryl group with primary amine antifungal, anticancer, antioxidant, anti-inflammatory, antimalarial ($R\text{-}NH_2$) amine in which the carbonyl group is changed by using and antiviral activity. Schiff base metal complexes are often referred to as imine or azomethine groups [1]. Schiff bases are well-known for their significant biological functions within photosynthesis and their strong coordinating nature as a family of ligands[2]. Since these compounds may contain distinctive substituents and can either be unbridged or N,N′-bridged, the Schiff base is particularly adaptable in nature. Schiff bases typically feature NO or N_2O_2 donor atoms, however oxygen may be swapped out for sulphur, nitrogen, or selenium atoms [3].

Schiff bases provide excellent intermediates in the synthesis of several bioactive substances. Additionally, they may be stated to reveal a range of biological activity, such as antibacterial, antifungal, antifertility, dioxygen coordination, anti-cancer, and herbicidal ones [4]. In other words, they could be a necessary component in the synthesis of different Schiff base ligands that are utilised as chiral auxiliaries in asymmetric synthesis. Oxidation processes have also used Schiff base metal complexes. Given these characteristics, Schiff base is crucial for biological, analytical, and medicinal chemistry processes as well as the food, dye, fungicidal, and analytical chemistry and catalysis industries. In this essay, we will discuss the importance of Schiff bases as well as some straightforward ways for synthesising them.

In coordination chemistry, a family of ligands known as schiff bases has been researched. Schiff base ligands may be easily produced and manufactured as complexes with practically all metal ions. Numerous studies on their biological effects, including their antibacterial, antifungal, anticancer, antioxidant, anti-inflammatory, antimalarial, and antiviral activity, have been published recently. Additionally, Schiff base metal complexes are well recognised for their crucial biological functions in photosynthesis and the transportation of oxygen in mammalian and animal respiratory system.

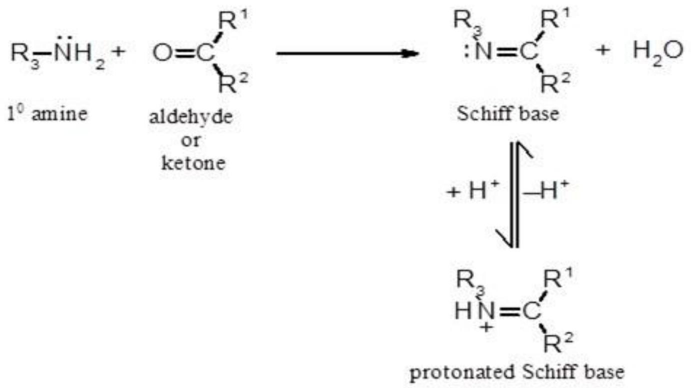

Figure 1.General path for preparation of Schiff bases.

These complexes also play a big part in industrial, medicinal, and agricultural chemistry. It has been shown that molybdenum (VI) Schiff base complexes may have four, five, or six coordinates depending on the solvent.

II. SCHIFF BASE COMPLEXES' BIOLOGICAL SIGNIFICANCE

The function of Schiff bases and their metal complexes as dyes, antioxidants, anti-inflammatory agents, antiviral, anti-cancer, and anti-fertility oxygen affinity agents is reviewed in this work.

2.1. Antibacterial activity

Schiff base metal complexes made from 2-thiophene carboxaldehyde and 2-aminobenzoic acid (HL) and Fe(III) or Co(II) or Ni(II) or Mo(VI) confirmed antibacterial activity towards Staphylococcus aureus, Enterobacter aerogenes, Salmonella typhi, and Bacillus subtilis. This activity was derived from the condensation of thenil with 2,3-d Escherichia coli was inhibited by the complexes of Fe(III), Cu(II), and Mo(VI). The significance of this is seen in the possibility of using these complexes to cure various illnesses brought on by Escherichia coli. However, compounds of Fe(III), Co(II), Cu(II), and Mo(VI) have been developed specifically to suppress Gram-positive bacterial strains. This unique characteristic of the discovered Schiff base metallic complexes is significant because it may be effectively employed to treat infections brought on by any of these specific strains[5]. Sulphametrole and varelaldehyde condensation produced a single Schiff base, and metal complexes of this base were tested against bacterial species. Escherichia coli (Gram-negative bacteria) and Staphylococcus aureus (Gram-positive bacteria) responded better to the newly synthesised Schiff base and its metal complexes, according to the results of the study[6].

The disc diffusion technique was used to test the antibacterial effects of the Schiff base 2-Aminomethylthiophenyl-4-bromosalicylaldehyde and its metal complexes against microorganisms. The results of antimicrobial interest demonstrate that metal complexes have antimicrobial capabilities and, in comparison to the parent ligand, display high inhibitory action. Chelation hypothesis was used to explain the antibacterial activity. The results showed that the tested complexes were more effective against Gram-positive bacteria than Gram-negative ones. One may draw the conclusion that the cell walls of the bacteria and the chemicals' antibacterial action are related.

Escherichia coli, Staphylococcus aureus, Bacillus subtilis, and Bacillus all exhibit antibacterial activity when interacting with tridentated Schiff bases and their metal complexes. Pumilus. A number of Schiff bases made from amino acids, aldimines, pyrazines, and heterocylic ketone also have antibacterial activity[9]. Mo(IV) and Mn(II) metal complexes containing hydrazine carboxamide and hydrazine carbothiamide have antibacterial action against Xanthomonas compestris and Staphylococcus aureus, respectively. Schiff bases (glucosamine, benzimidazole, furaldehyde, thiazole, pyridine, benzyldithio-carbazate, and pyrazolone) have antibacterial activity. Isatin-derived Schiff bases offer anti-HIV and antibacterial properties. Salicylidene derivative metal complexes with neutral tetradentate have antibacterial activity against Kelbsiella pneumonia, Staphylococcus aureus, Salmonella typhi, and Bacillus subtilis. Organo-silicon (IV) complexes with bidentate Schiff bases and organo-lead (IV) complexes with nitrogen donor ligands of sulpha pharmaceuticals have antibacterial properties.

2.2. Antifungal Activities

The antifungal effects of metal complexes with Schiff bases made from the amino acids glycine, L-alanine, and L-phenylalanine (where metal, M= Cu(II), Co(II), Ni(II), and Mn(II)) have been studied. The inhibition of Cu(II) and Ni(II) complexes is verified to be closer to that of all the examined bacteria. While VO(II) complexes show no action against the bacteria, Co(II) and Mn(II) complexes exhibit less inhibition. In order to determine their ability to suppress growth, metal complexes of Cr(III), Mn(III), and Fe(III) in ethanolic medium with Schiff base ligand made from 1,4-dicarbonyl-phenyldihydrazide and chromene-2,3-dione (2:2) were first produced. The compounds' antifungal trial results were compared to the same-old antifungal medication (Miconazole) at the same concentration. All of the combinations were quite effective at preventing the growth of Aspergillus species. Despite this, they are less interested in combating rhizoctonia species than the common antibiotic miconazole. The Cr(III) and Fe(III) complexes are far more effective against Penicillium species than the conventional medication. According to the results, the antifungal activity changes according to the metal ion in the following order: Cr > Fe > Mn.

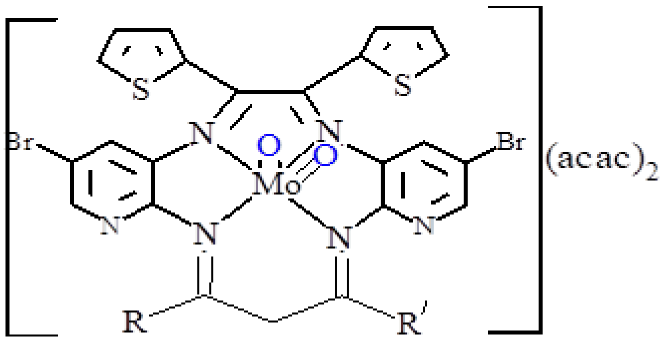

Figure 2. Proposed structure of Molybdenum complexes with Schiff base.

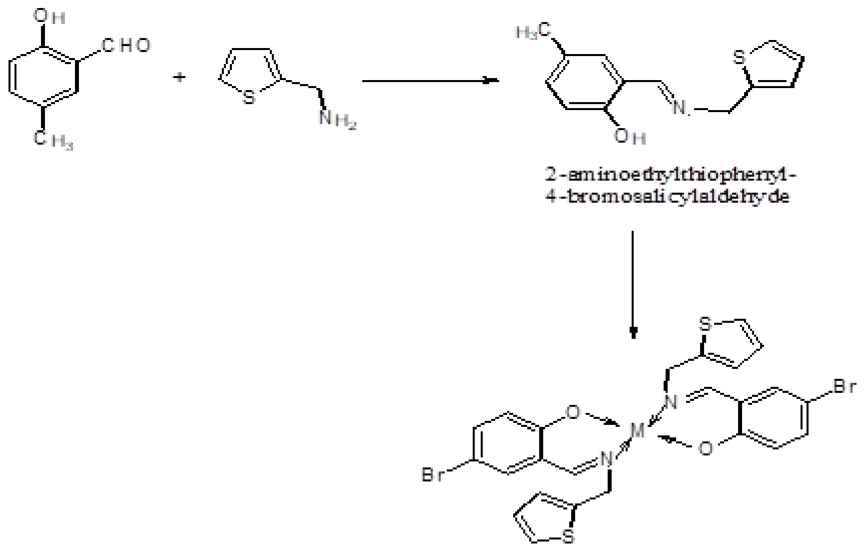

Figure 3. Proposed structure of Schiff base ligand and its metal complex as where M=Cu(II), Ni(II).

In opposition to *Aspergillus Niger* and *Alternaria alternata*, metal complexes of As (III), Sb (III), and Bi (III) with o- tolylammonium di-thiocarbamate are antifungal. Disease in a crop of brinjal is tested by Mo and Mn complexes (induced by Alternaria alternata). Aspergillus niger and Alternaria alternate are both susceptible to the microbiological activity of Schiff bases like phenyl-azo-thiazole and benzothiazole and their metallic complexes. The physiological action of pyrandione Schiff bases is directed at Aspergillus niger. Benzothiazole and thiazole Strong antifungal properties are provided by Schiff bases [10]. The fungicidal action against Curvularia is enhanced by the presence of methoxy, halogen, and napthyl groups. Tetranychus bimaculatus may be killed by using metal complexes (metal M= Ni(II), Cu(II), and Zn(II)) made from the salicylaldehyde Schiff base and O,O-dimethyl thiophosphoramide.

2.3 Antifertility Activity

Additionally, bis(3-oxo-2-butylidene)propane-l,3-diamine Schiff base and Sn(II) metal complexes may alter reproductive physiology. Rats given different complexes orally had significantly less sperm in their testes and epididymis. Sperms from the cauda epididymis also noticeably lose their mobility. All of the experimental groups were examined for a significant decrease in the cauda epididymis' sperm motility. This could be caused by the oxidation phosphorylation uncoupling interfering with enzyme processes. The reproduction system may be adjusted by the Schiff base of hydrazine carboxyamide and metal complexes of MoO_2(VI) and Mn(II). Protein enzyme activity is destroyed by Schiff base links with pyridoxal from lysine to analine or histidine.

2.4 Oxygen Affinity

Research on synthetic dioxygen carriers is substantial. Examples include the reversible binding of the dioxygen by salen, porphyrin, tertiary phosphine, and phthalocyanine complexes of Co, Mn, Fe, Mo, and Cu. Tsumaki investigated the salen-type compounds' ability to activate molecular oxygen in 1930.

The N,N'-bis (salicylidene)-2,2'-dimethyl-1,3-propanedimine ligand derivative cobalt(II) complexes, also known as CoSaldmpr, exhibit oxygen absorption properties. In a solution of 1-methyl-2-pyrrolidinone (NMP), the complexes produced amazing results. The loading of Co(3-methoxySaldmpr), measured in (g O_2/g solution), remains around 35% greater than Co(3-methoxy-Salen) for at least four sorption (absorption/desorption cycles) using 2-cyanopyridine (2 M) as the axial base and their complexes. In DMF and chloroform solvents, ethylenediamine was condensed with salicylaldehyde, o-hydroxyacetophenone, or acetyl acetone to produce square planar complexes of Mn(II), Co(II), and Ni(II) of tetradentate Schiff base ligands. The sorption processes have proceeded with pyridine:metal (II) complexes in a 1:1 molar ratio in both the presence and absence of axial base. Pyridine serves as the axial basis in this instance. The oxygen affinity of complexes in DMF is much higher than that of chloroform solvent. Co(II) complexes, as opposed to Mn(II) and Ni(II) complexes, demonstrated excellent sorption processes. The pyridine axial base's presence blatantly increases oxygen affinity. This kind of material may be employed as a replicably eco-friendly catalyst in oxidative addition processes in organic chemistry and petrochemicals.

Due to the fact that oxy-molybdenum chemistry is so important, most molybdo-enzymes include these units in their active sites. Numerous oxomolybdenum compounds had been produced and studied to imitate biological systems. According to spectral investigations, the geometry of this kind of molybdenum coordination complex is deformed. In terms of geometry, the ONO tridentate ligand is positioned meridionally with two anionic oxygen donors connected trans and cis to the cis-dioxo group's oxygen centres. The literature has proposed that cis-MoO_2 (ONO)-type complexes may be used in oxo transfer processes such as sulfoxidation, epoxidation, and phosphine oxidation reactions.

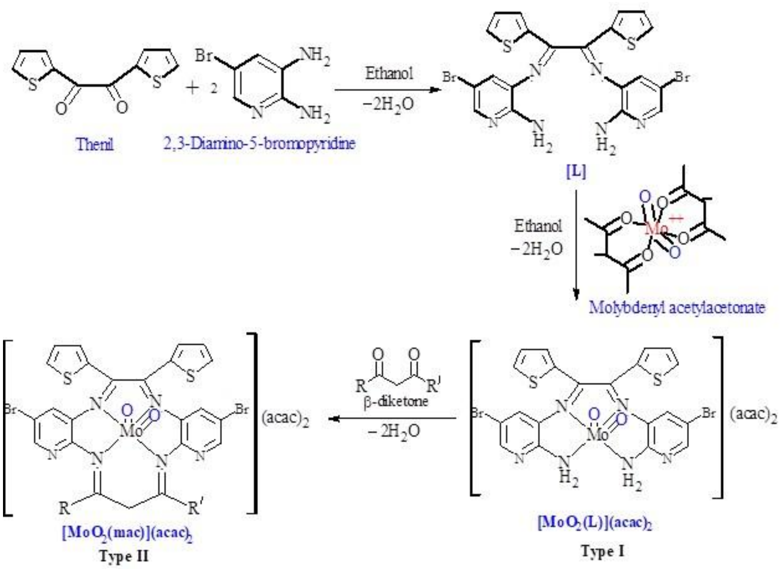

Figure 4. Scheme for preparation of tetradendatemacrocyclic complexes of dioxomolybdenum(VI) complexes.

Where, L = thenil+ 2,3-diamino-5-bromopyridine; mac = macrocyclic ligands carried out from condensation of L with β-diketones in presence of dioxmolybdenum(VI) cation; R = CH_3, C_6H_5, C_4H_3S, C_6H_5; R' = CH_3, CH_3, CF_3, C_6H_5; respective with β-diketones = (i) acetylacetone, (ii) benzoylacetone, (iii) thenoyltrifluoroacetone, (iv) dibenzoylmethane.

2.5. Antiviral Activities.

The structure of novel antiviral compounds may be easily designed using the salicylaldehyde Schiff bases of 1-amino-3-hydroxyguanidine tosylate. Excessive antiviral activity is seen in Gossypol Schiff bases. Cucumber mosaic virus is inhibited by Ag(I) complexes. Strong results up to 74.5% against the C. mosaic virus were generated by the glycine salicylaldehyde Schiff base Ag(I) complex. Strong inhibitors of the mouse hepatitis virus were produced by Schiff bases generated from 1-amino-3-hydroxyguanidine tosylate and 2-(3-allyl-2-hydroxybenzylidene)-N-hydroxyhydrazinecarboximidamide derivative (MHV).

2.6 Anticancer activity

The most dreaded diagnosis in the world, cancer is a severe public health issue everywhere. In both developed and developing nations, it ranks second in terms of causes of fatalities for people, after heart disorders. A collection of cells exhibit uncontrollable proliferation when they have cancer. Most malignancies are now treated primarily with surgery and chemotherapy, but the therapeutic effects of these treatments are not very advanced, and they have a lot of adverse effects. Over the last fifty years, there has been a significant effort put into creating more potent medications for cancer patients. Many complexes and derivatives of Schiff bases have been shown to have anticancer effects in recent years.

Aryl-azo Schiff has anti-cancer properties. K B cell lines are inhibited by the Schiff base of indole-2-carboxaldehydes. Numerous Schiff bases and their metal complexes (metal, where M=Co, Ni, Cu, and Zn) have anticancer characteristics. Salicylaldehyde, 2,4-dihydroxy-banzaldehyde, glycine, and L-alanine are used to make these kinds of metal complexes. Ni> Cu>Zn>Co is the order in which these agents react with metal. Salicylidiene anthranilic acid has antiulcer activity, and copper complexes containing this compound also have significant antiulcer activity.

An order of Ru(II) and Ru(III) complexes containing 4-hydroxy-pyridine-2,6-dicarboxylic acid and PPh_3/$AsPh_3$ have been produced in order to develop more potent, precise metal medicines that are less toxic and assess their anticancer characteristics.

2.7. Dyes

Fur, food packaging, wool, and other materials may be dyed quickly using chromium complexes with azomethine, cobalt complexes with Schiff bases, and unsymmetrical complexes 1:2 chromium. Textiles made of cellulose and polyester are dyed using metal complexes containing azo groups. The bulk dyeing of polyfibers uses several metal complexes. Salicylaldehyde with diamine, the Schiff base compound of cobalt that does not disintegrate even in acidic gases, has improved mild resistance and storage capacity (CO_2).

Two low-dimensional oxime-containing Schiff base copper (I/II) complexes with iodineecopper cluster $[Cu^{I}_2I_4]^{2-}$ bridges, namely $\{[Cu^{II}_4I_3(pop)_4]_2(Cu^{I}_2I_4)\}.(CH_3CN)_2.H_2O$ (2) and $[Cu^{II}_4I_2(pop)_4(Cu^{I}_2I_4).(CH_3CN)]_n$ (3) (Hpop = 2-(hydro-xyimino)- N'-[1-(2-yridyl)ethylidene] propane-ydrazone), were prepared from the reaction of [2x2] grid-like compound $\{[Cu^{III}(pop)]_4\}_2.4H_2O$ (1) with equivalent $Cu^{I}_2I_2$ (iodineecopper clusters) under solvothermal condition and characterizated by means of elemental analysis, infra-red spectrum, thermogravimetric analysis, and X-ray single-crystal/powder diffraction. The results exhibit that 2 is 0-D discrete structure from group of one $[Cu^{I}_2I_4]^{2-}$ unit and two [2 x2] molecular grids 1 via μ_3-I atom coordinating to Cu(I) /Cu(II) atoms. But, compound 3 shows 1-D wave-like chain, that's shaped by using coordination of μ_2-I atoms from $[Cu^{I}_2I_4]^{2-}$ units with Cu(II) atoms in [2x 2] molecular grids (1). Moreover, catalytic experiments showed that compounds 2 and 3 have promising visible-light-driven catalytic interest in degrading various organic dyes.

2.8. Antioxidant Activity.

Under specific environmental circumstances and during routine cell processes in the body, free radicals are created. Antioxidants are essential for shielding the human organism from reactive oxygen species damage. An essential quality of Schiff bases and their metal complexes is their ability to scavenge free radicals. Many Schiff-base metal complexes have recently been studied for their antioxidant properties.

The antioxidant potential of five different types of chitosan and carboxymethyl chitosan (CMCTS) Schiff bases was investigated utilising superoxide and hydroxyl radical scavenging. Significant variations have been found between the Schiff bases of chitosan and carboxymethyl chitosan. It could be connected to the presence of active amino and hydroxyl groups in the molecular chains. As growth within the Schiff concentration grows, so does the scavenging effect. Nowadays, synthetic or artificial antioxidants are often employed since they are more efficient and cost-efficient than natural antioxidants. Today, a variety of Schiff base metal complexes have been created and are potent ROS scavengers and antioxidants.

The DPPH approach has been used to assess the antioxidant properties of the Schiff base ligand N-(4-phenylthiazol-2-yl)-2-(thiophen-2-ylmethylene) hydrazinecarboxamide and its Cu(II), Co(II), Ni(II), and Zn(II) complexes. In contrast to Ni(II) and Zn(II) complexes, the Schiff base ligand and its Cu(II) and Co(II) complexes have shown excellent antioxidant activity. Concentration is necessary for scavenging. The presence of >NH groups may result from the Schiff base ligand and its copper complex exhibiting the requisite free radical scavenging effect. It ought to provide DPPH with an electron or a hydrogen atom in order to create a stable free radical. The 2-Hydroxy-1- naphthaldehyde (HN) Schiff base complexes with tin (II) chloride were created, and their antioxidant properties were assessed using the DPPH method. Each compound had excellent antioxidant properties, with better properties than the corresponding ligands.

Sulphanilamide Schiff bases and their complexes with metals including Cu, Zn, and Cd have been studied as antioxidants. The metal complexes of Cu and Zn have a little antioxidant action. Cd's metal complexes, however, have strong antioxidant action. The combination of metal with the condensed ring structure gives the complexes a pronounced antioxidant interest. The capacity of the condensed ring structure to stabilise unpaired electrons and scavenge free radicals will rise.

III. CONCLUSION

Due to their capacity to form complexes with transition metal ions and their biological characteristics, schiff bases are recognised as a particularly dominating category of organic molecules. Schiff bases and their associated metal complexes have long been employed in a variety of industrial settings. However, more study has to be done on this category of chemicals' antioxidant properties. When plant pathogens are taken into account, it reveals. Additionally, there have been more and more research on this topic that demonstrate the effects of Schiff bases on pathogens of therapeutic importance. I have examined Schiff bases, which are excellent at forming complexes with metal ions, and shown that these Schiff bases and their metal complexes are of interest for antioxidants. Schiff base metal complexes are very selective and superior oxygen carriers. The foundation for the usage of these antioxidants will be implemented by the synthesis of the most recent macrocyclic Schiff base ligands and their use as chelates.

Transition metal complexes containing Schiff bases have attracted a lot of attention in recent years owing to their diverse biological uses and significant potential for developing novel therapeutics. Additionally, further research into the biological effects of previously generated Schiff base transition metal complexes as well as the creation of novel complexes with additional features may be necessary. Schiff bases and their metal complexes served as models for creating chelates that were more effective. Analysis of the structure, activity correlations, and mechanism of action of these Schiff bases and their metal complexes would be necessary for advent in this topic.

REFERENCES

[1]. Hong, X.J.; Liu, X.; Zhang, J.B.; Wu, X.; Chu-Ling, L.; Ou, Y.J.; Yang, J.; Jin, H.G.; Cai, Y.P. Two low-dimensional Schiff base copper(I/II) complexes: synthesis, characterization and catalytic activity for degradation of organic dyes. CrystEngComm **2014**, 16, 7926-7932, https://doi.org/10.1039/C4CE01207K.

[2]. Arulpriya, P.; Lalitha, P.; Hemalatha, S. In vitro antioxidant testing of the extracts of Samaneasaman (Jacq.) Merr. Der Chemica Sinica **2010**,1, 73-79.

[3]. Guo, Z.; Xing, R.; Liu, S.; Yu, H.; Wang, P.; Li, C.; Li, P. The synthesis and antioxidant activity of the Schiff bases of chitosan and carboxymethyl chitosan, Bioorganic Medicinal Chemistry Letters **2005**, 15, 4600-4603, https://doi.org/10.1016/j.bmcl.2005.06.095.

[4]. Mruthyunjayaswamy, B.H.M.; Nagesh, G.Y.; Ramesh, M.; Priyanka, B.; Heena, B. Synthesis, characterization and antioxidant activity of Schiff base ligand and its metal complexes containing thiazole moiety. Der Pharma Chemica **2015**, 7, 556- 562.

[5]. Subba, R.Y.; Prathima, B.; Adinarayana, S.; Madhavi, K.; Varada, R.A. Complexes of Cu(II) and Ni(II) with Bis(phenylthiosemicarbazone): synthesis, spectral, EPR and in vitro-antibacterial and antioxidant activity. Journal of Chinese Chemical Society **2012**, 57, 677-682, http://dx.doi.org/10.1002/jccs.201000094.

[6]. Neelofar, A.; Nauman, A.; Shabir, M.A.; Naser, M.A.S.; Riaz, U.; Robila, N.; Sohail, A. Synthesis and evaluation of antioxidant and antimicrobial activities of Schiff base tin (II) complexes. Tropical Journal of Pharmaceutical Research **2016**, 15, 2693-2700, http://dx.doi.org/10.4314/tjpr.v15i12.22.

[7]. de Sa Junior, P.L., Camara, D.A.D., Porcacchia, A.S., Fonseca, P.M.M., Jorge, S.D., Araldi, R.P., Ferreria, A.K. The roles of ROS in cancer heterogeneity and therapy, Oxidative Medicine and Cellular Longevity, **2017**, vol. 2017, article ID 2467940, 12 pages.

[8]. Slassi, S., Fix-Tailler, A., Larcher, G., Amine, A., El-Ghayoury, A. Imidazole and azo-based Schiff bases ligands as highly active antifungal and antioxidant components, Heteroatom Chemistry, **2018**, vol. 2019, article 6862170, 8 pages.

[9]. Siddappa, K.; Mayana, N.S. Synthesis, spectroscopic investigation and biological evaluation of some transition metal complexes of a 3-(((2-hydroxyquinoline-3- yl) methylene) hydrazine) indolin-2-one. International Journal of Pharma and Bio Sciences **2014**, 5, 162-174.

[10]. Sashidhara, K.V.; Kumar, A.; Bhatia, G.; Khan, M.M.; Khanna, A.K.; Saxena, J.K. Antidyslipidemic and antioxidative activities of 8-hydroxyquinoline derived novel keto-enamineSchiffs bases. European Journal of Medicinal Chemistry **2009**, 44, 1813-1818, https://doi.org/10.1016/j.ejmech.2008.08.004.