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REVIEW ARTICLE

Biological Activity Study of Schiff Base ligands and their Complexes: A Review

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Abstract

Schiff Bases (SB) stand for multipurpose ligands created from prime amines condensing with carbonyl groups. These represent imperative compounds in pharmaceutical and medical domains as a consequence of their widespread spectra of organic performances. The majority of them exhibit antibacterial, antifungal and antitumor activities. Transition metal compounds based on biological SB ligands were extensively investigated. This study reviews the synthesizing and organic activities of SB and its complexes.

Keywords: *Metal complexes, Schiff Bases, Antitumor activity, Antimicrobial activity, Nonlinear optical properties.*

Introduction

Schiff Bases (SB) or compounds with (CH=N-) azomethine group can be made as a result of primary amine condensation using carbonyl compounds [1, 2]. Aliphatic aldehyde SBs have been somewhat unsteady and are freely polymerizable. But, aromatic aldehydes with in effect conjugating scheme have been higher in stability [3, 4].

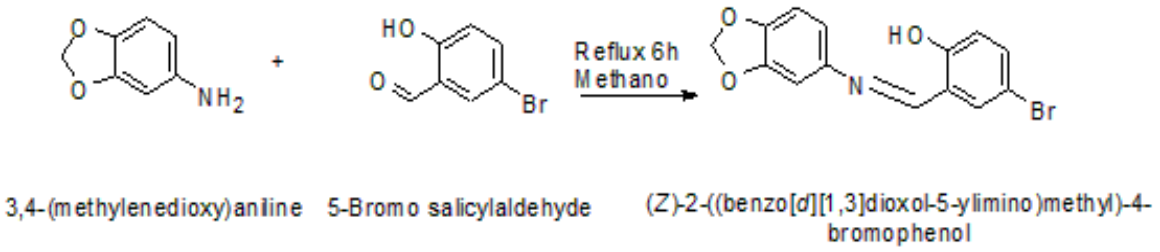
SBs possess numerous applications viz., identification, preparative use, determination or detection of ketones and aldehydes, carbonyl or amino compounds purification, or protecting those groups throughout susceptible reactions or complex [5, 6].

As well, basic units have been by produced by SBs in definite dyes. They have been in general bi-or tri- dentate ligands able to form highly stable compounds with transitional metals. Approximately, several of them can be employed as liquid crystals. In biological synthesis, SB reactions have been suitable in creating bonds of carbon-nitrogen.

They have imperative transitional medium in numerous enzymatic reacting including interacting the enzyme with the carbonyl and amino cluster of a substrate. For instance, biochemical process that has primary amine condensation in the enzyme typically has lysine residue with a carbonyl cluster to generate an imine, or SB for the substrate [7]. Stereo chemical analysis has done using molecular version and it has shown that formed SB amid methyl glyoxal and amino group of lysine side chains of proteins are bent back concerning N atom of peptide collections in which a charge transfer is feasibly taken place amid those collections and oxygen atoms of SB [8, 9].

This study focuses on a creation and organic performance of SBs along with its compounds. Cd (II), Zn (II), Cu (II), Ni (II), Co (II), Fe (III), Mn (II), Ag (I) and Hg (II) were produced from SB ligand, organized as a result of 3,4-(methylenedioxy) aniline and 5-bromo salicylaldehyde condensation. Vitro antimicrobial influences of formed complexes have been investigated in contradiction of 5 bacterial along with 3 fungal species through fit diffusion process.

Antioxidant performances were as well accomplished for each complex. Metallic compounds have more organic performances as compared with SBs [10].



Scheme 1: SB ligand synthesizing

About 5 newfangled metal complex derivatives of 2N-salicylidene-5-(p-nitro phenyl)-1,3,4-thiadiazole (HL) with the metal ions Co (II), Vo (II), Pd (II), Rh (III) and Au (III) were effectively organized in alcoholic media. The initial vitro antibacterial screening results have shown that complexes have sensible performance in contradiction of investigated bacterial strains to some extent more than ligand, HL [11].

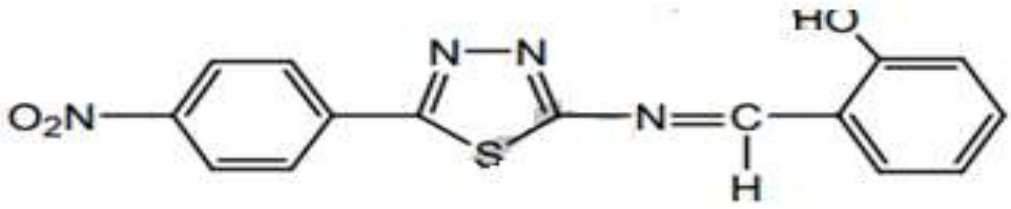
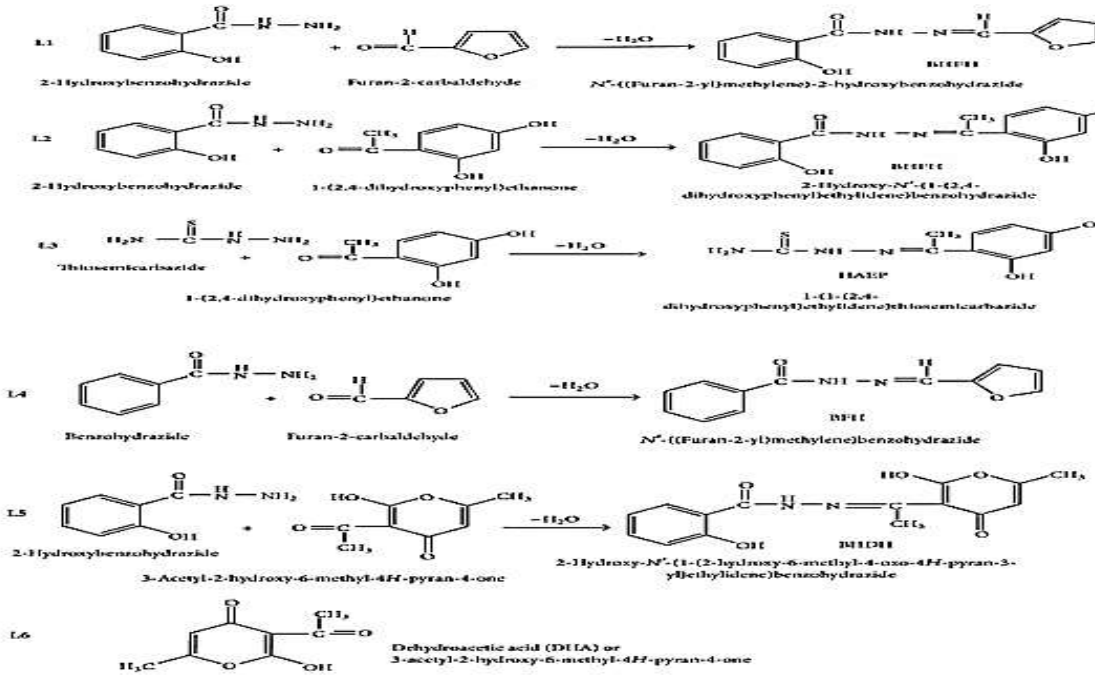


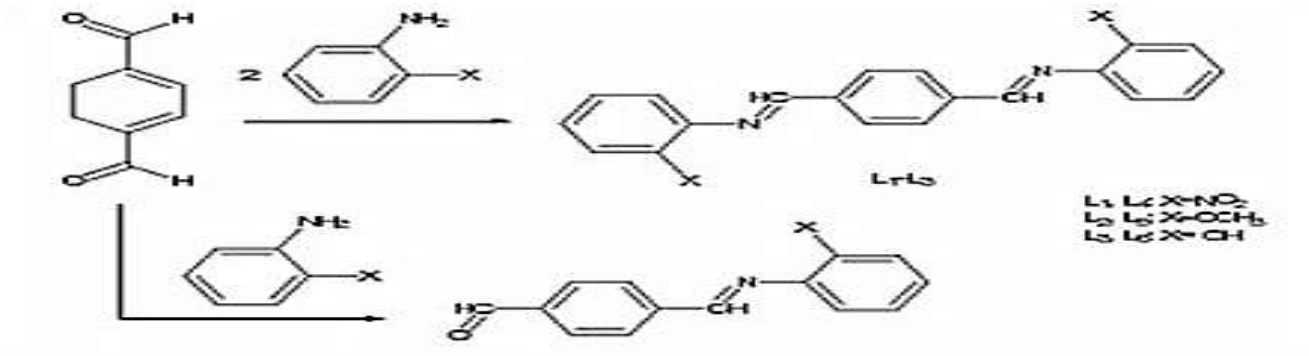
Figure 1: HL ligand Structural Geometry

Ni (II), Cu (II), Fe (III), Co (II), Cr (III), Mn (II) and VO (II) with six ligands made as a result of condensation products by means of azides and ketones or aldehydes have been characterized for coordination complexes. The experimental biological performance has been boosted for the metal complexes than uncomplicated metal salts or ligands, excluding HAEP and L3 ligand, where the free –OH and –NH2 clusters were repressed the activity on the ligand. Moreover, the activity order is reliant on raised atomic weight of the used metallic ion. VO (II) complexes in several cases have been better as compared with used standards for bactericide as well as fungicides [12].



Scheme 2: Formed SBs Ligands

N-propyl-benzoguanamine-SO_3H magnetic nanoparticles (MNPs) have been employed as a catalyst formation of newfangled SB ligands from condensation reacting of terephthalaldehyde along with ortho-aniline derivatives. The activity of antibacteriality of ligands and their metallic compounds have been partitioned by means of disc diffusion and broth dilution approaches in contradiction of Serratia marcescens, Escherichia coli, gram negative bacteria (Pseudomonas aeruginosa), Bacillus Subtilis and gram positive bacteria (Staphylococcus aureus). Ligand with hydroxyl cluster has been exhibited superior organic actions than other ligands. The consequences have exhibited that the metal complexes possess greater antiseptic activity than parent ligands and CoL3 complex has been further effectual as compared with other used metallic complexes in contradiction of each tested bacteria. It has been in effect in contradiction of Pseudomonas aeruginosa in the case of 17 mm diameter inhibiting zone and 0.15 mg/mL marginal inhibitory concentration [13].



Scheme 3: the synthesis of new Schiff base ligands

The formation and fundamental depiction of a 2-phenyl- 3(benzamido propyl) quinazoline (3H) -4- one semicarbazone/ thiosemicarbazone hydrochloride along with its metallic compounds were stated. The ligands along with its metallic compounds have been investigated for their potential antimicrobial activity [14].

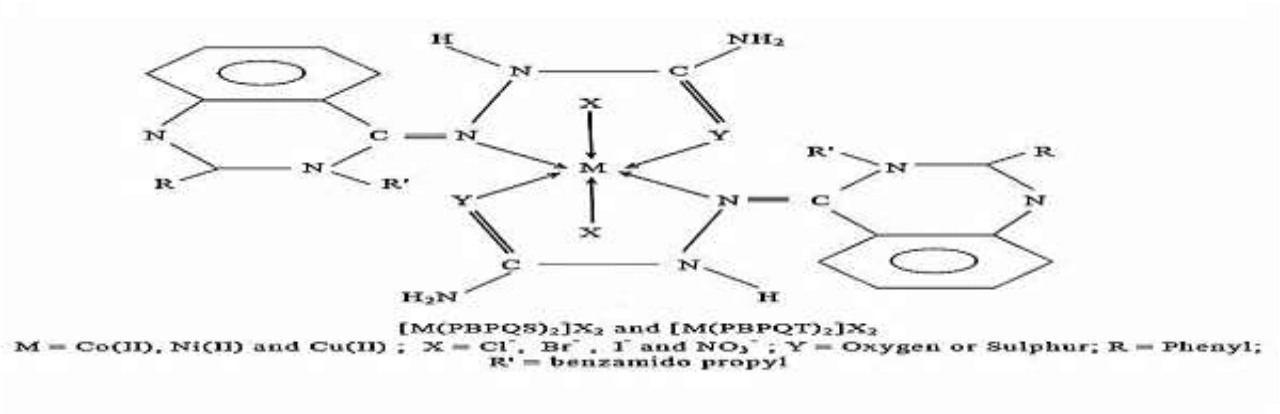


Figure 2: complexes with SB ligands structure

Zn (II), Ni (II), Sn (II), Mn (II), Co (II) and Cd (II) ions as for chosen metallic complexes have been formed with 3 diverse formed SB ligands. SBs along with their metallic complexes were in medium level as compared with resilient antimicrobial action [15].

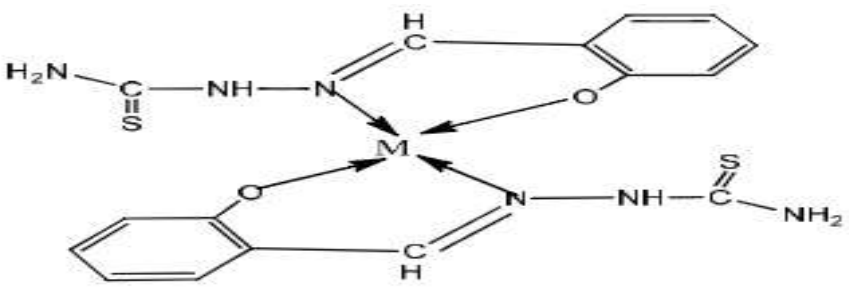
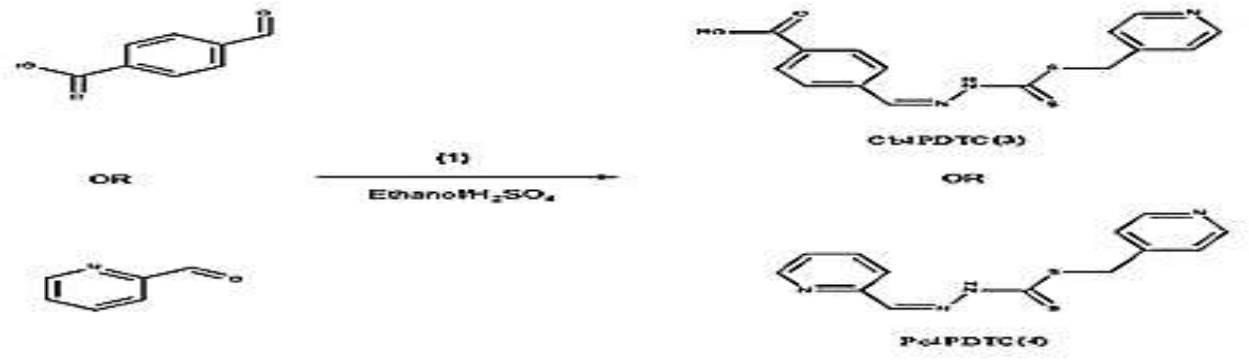


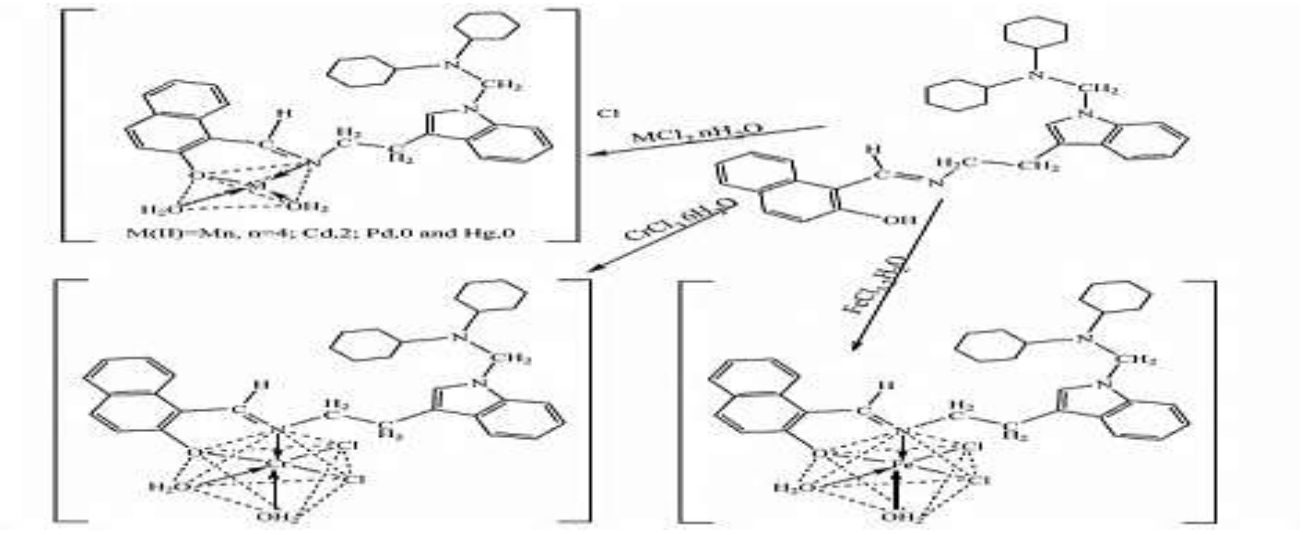
Figure 3: SB ligand Structures

Dithiocarbazate moiety substitution was organized by means of 4-picolylchloride hydrochloride to acquire S-4-picolyldithiocarbazate (S4PDTC) and S4diPDTC. Dual SBs have been formed through S-4-picolyldithiocarbazate reacting with pyridine-2-carboxaldehyde (Pc4PDTC) in addition to 4-carboxybenzaldehyde (Cb4PDTC). Ligands as well as their metal compounds have been analyzed in vitro for antimicrobial, antioxidant and cytotoxic behaviors. Pc4PDTC SB has depicted reasonable cytotoxicity in contradiction of humanoid promyolicytic leukemic (HL60) cell line with 9 lg/cm3 CD50 magnitude whereas Cb4PDTC has been sluggish. Pc4PDTC complexing with Cd (II) and Cu (II) has boosted its cytotoxicity in contradiction of HL60 humanoid promyolicytic leukemic cell line from moderate to high activation levels. S4PDTC has shown noticeable antimicrobial action in contradiction of bacteria, however, it has been dormant concerning fungi. Cu (II) along with Cd (II) complexes of dual SBs has shown pure inhibiting zones for the majority tested bacteria as well as fungi. Antioxidant features of Cb4-PDTC and Pc4-PDTC SBs have been equivalent to the available commercially buthylated hydroxy toluene (BHT) [16].



Scheme 4: Formation route of ligands

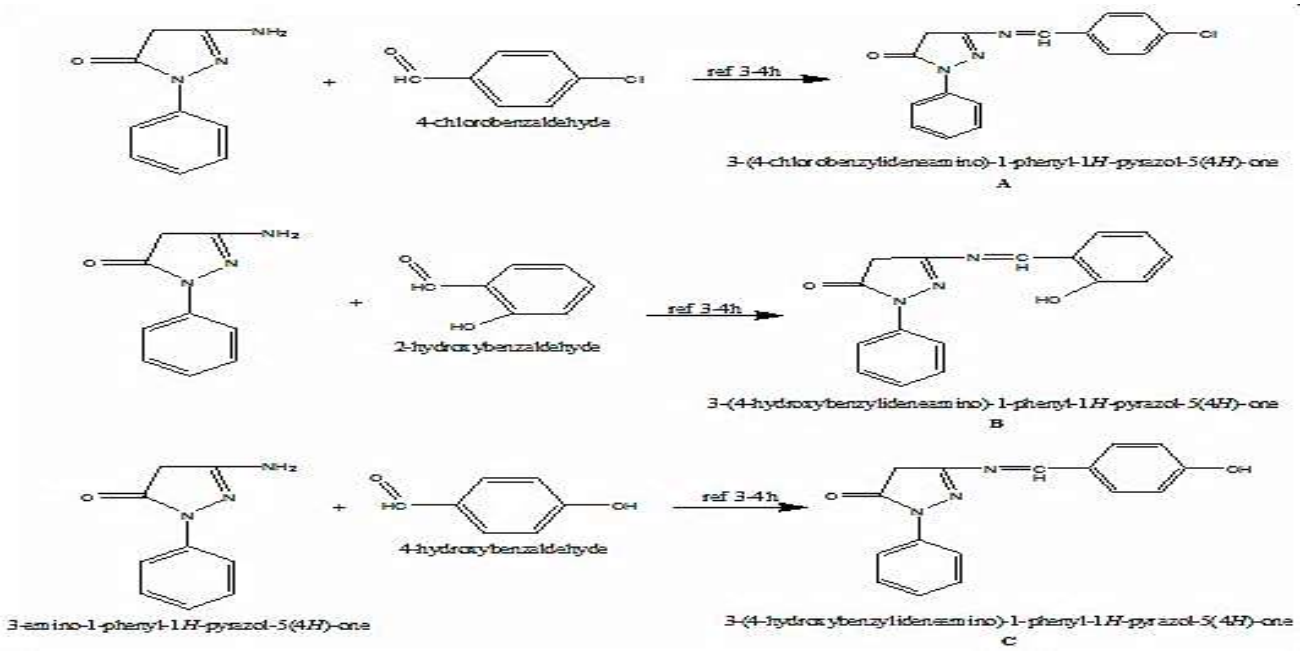
The new SBs (HL) has been organized from 1- {[2- (1H-Indol-3-yl) -ethylimino] methyl} -naphthalen-2-ol and dicyclohexyl amine. The organic results were investigated in vitro in contradiction of Pseudomonas aeruginosa, Staphylococcus aureus in addition to fungi like Fusarium graminearum, Penicillium expansum, Candida albicans and Macrophomina phasealina bacteria with the purpose of evaluating their antimicrobial potentiality [17].



Scheme 5: The synthesis route of complexes

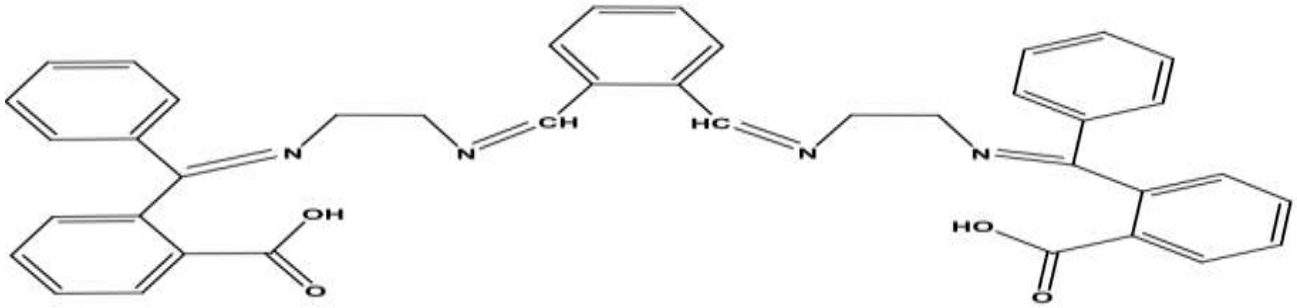
Ni and Cd complexes of new SB resulting from 5-Amino-2-phenyl-2,4-dihydro-pyrazol-3-one with 4-chlorobenzalaldehyde (A) , 2-Hydroxy-benzalaldehyde (B) and 4-Hydroxy-benzaldehyde (C) have been prepared.

The biological activities for the three ligands and its complexes have been considered and the results have exhibited that all complexes possess various activities against bacteria [18].



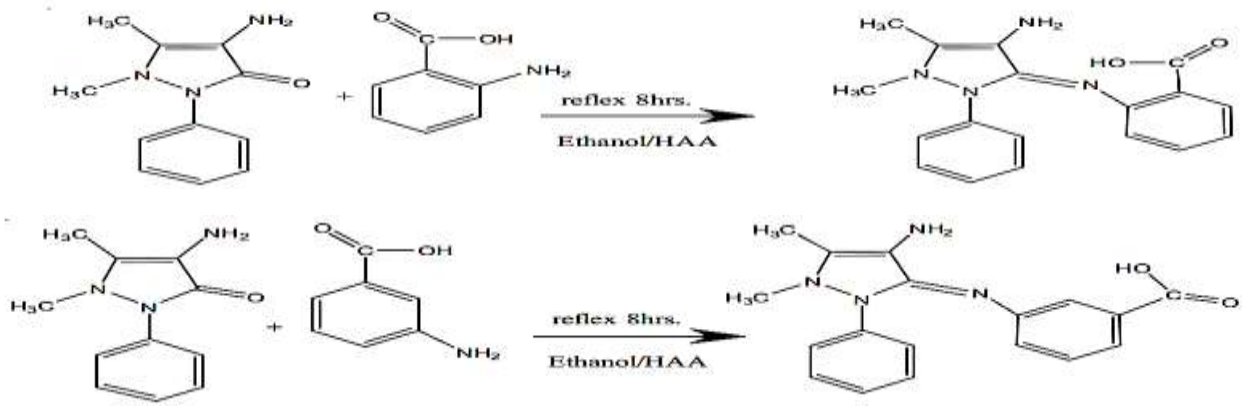
Scheme 6: The synthesis route of ligands

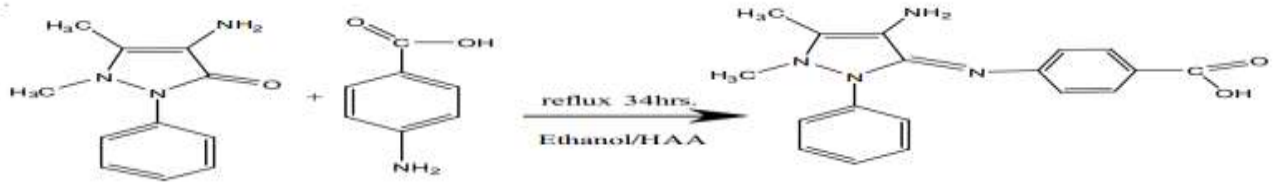
Two new ligands [H_4L_1] and [H_2L_2] were prepared by condensed ophathaldehyde with ethylene diamine and [N1, N1'E, N1, N1'E)-N1, N1'-(1, 2-phenylenebis (methan-1-yl-1ylidene)) diethane-1, 2-diamine] with 2-benzoyl benzoic acid. Antimicrobial investigations display worthy consequences in the shared compounds [19].



Scheme 7: The synthesis route of ligand [H2L2]

Three new Schiff bases and their Co (II), Ni (II) and Cu (II) and Hg (II) complexes made through condensation of 4-amino antipyrine with derived minobenzoic acid (3-aminobenzoic acid, 2-aminobenzoic acid in addition to 4-aminobenzoic acid) have been prepared by conventional approaches. The prepared compounds offered a good effect on the organisms; Escherichia coli, bacteria Staphylococcus aurous, fungi C. albicans in addition to A. niger. The organic products signalize which the mixed complexes show objectively worthy performance compared to all the investigated bacterial strains, and generally the action order of the produced complexes has been characterized as Ni(II) > Cu(II) > L [20].





Scheme 8: Synthesis of ligands [A1], [A2] and [A3]

New mixed ligand Schiff base complexes of Co(II), Mn(II), Cu(II), Ni(II), Cd(II), besides Hg(II) are formulated from (L) SB resulting from o-phathalaldehyde (o-PA) with p-nitroaniline (p-NA) as a primary ligand and anthranilic acid as a subordinate ligand. The study of organic performance of ligand SB and its complexes show numerous activities in contradiction of four type of bacteria two gram (+) and two gram (-) [21].

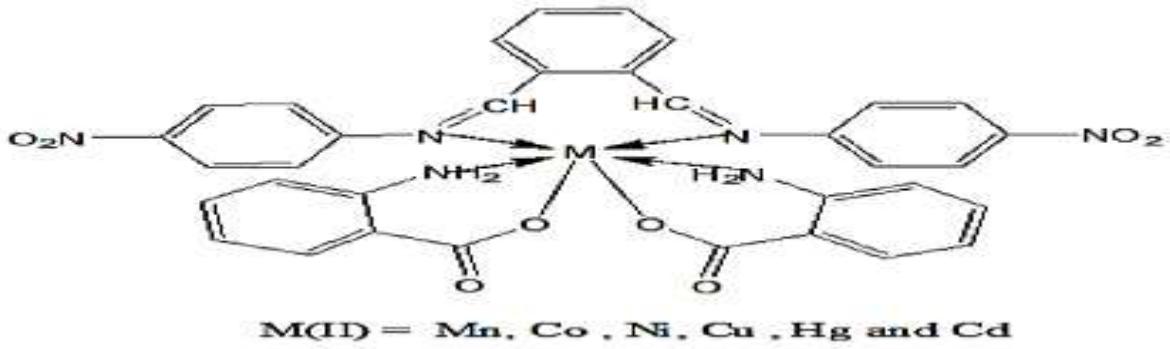
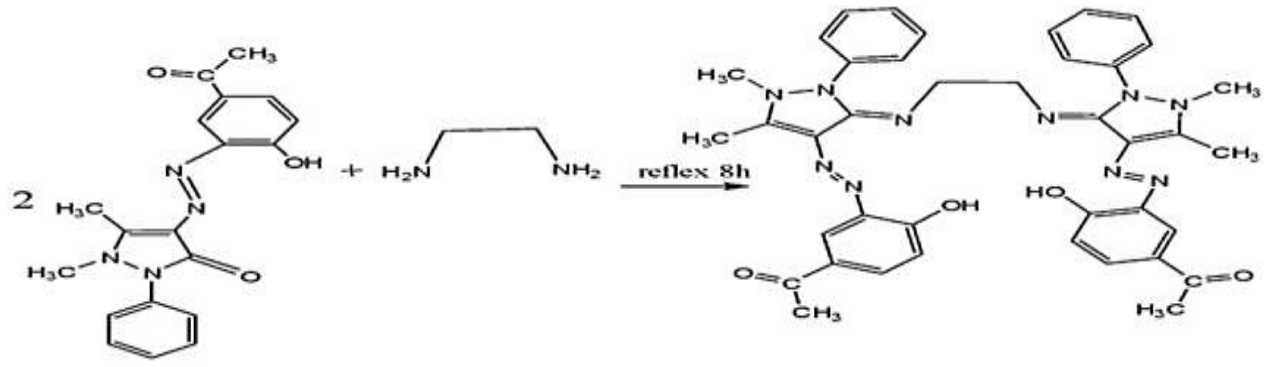


Figure 4: The synthesis route of [L1 (M) (Anth)2] complexes

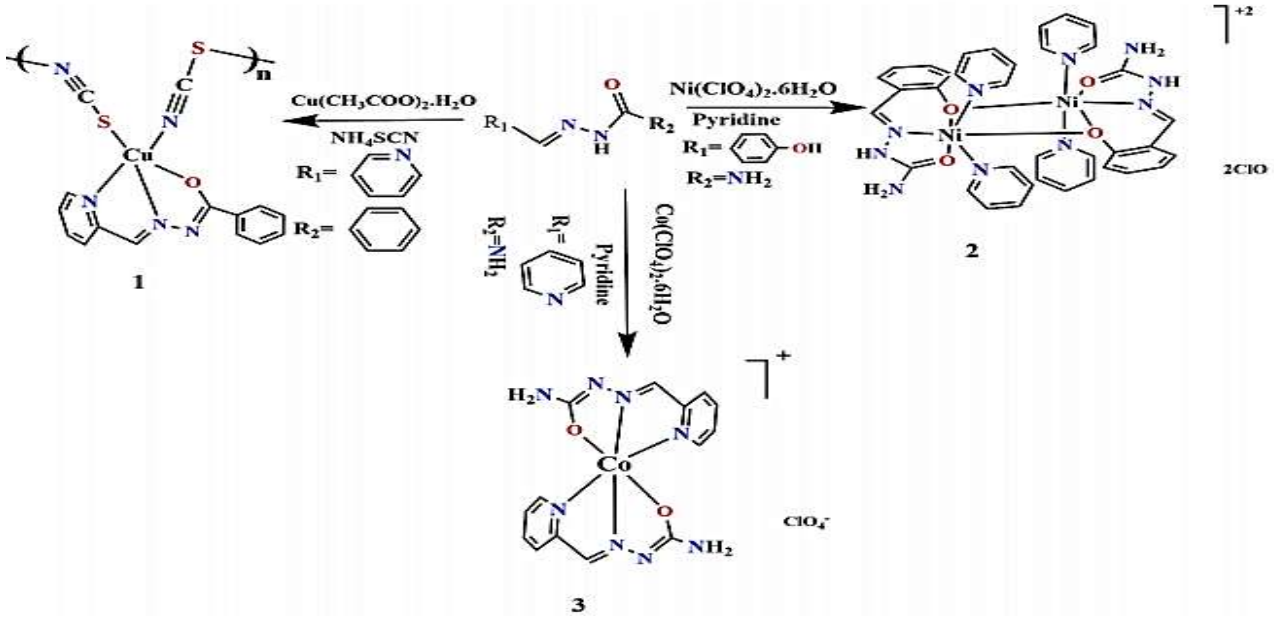
Novel Cu(II), Co(II), Ni(II), Cd(II), Zn(II) compounds of SB of Azo Ligand [H_2AZDP]are prepared from 4-amino antypyrine, 1-(4-hydroxyphenyl)ethan-1-one, and ethylene-1,2-diamine. Each complex has been partitioned for their antiseptic and antifungal performances via MIC process. Additionally, DNA cleavage result by Agarose Gel Electrophoresis (AGE) method and antioxidant result has been implemented via 2, 2-diphenyl-1-picryl-hydrazyl (DPPH). The molar conductivity and magnetic susceptibility measurements signalized that the prepared complexes are designated with an octahedral arrangement. DNA cleavage performance of complexes on Calf-thymus DNA (Cat.No-105850) molecule has shown sensible activity. Furthermore, the antimicrobial activity consequences have shown that the metal complexes have been higher in activity levels as compared with the free ligand. All the newly prepared compounds showed moderate biological activity [22].



Scheme 9: Schiff Base-Azo Ligand [H2AZDP]

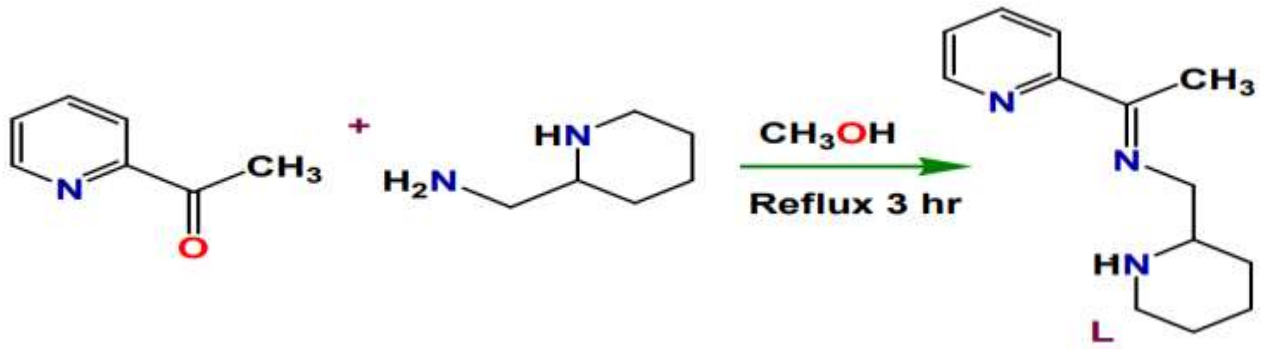
Cu (II), Ni (II) and Co (III) compounds with SB ligands taken from hydrazone, (HL1 = (E)-N′-(pyridin-2-ylmethylene) benzohydrazide, H_2 L_2 = (E)-2-(2-hydroxybenzylidene) hydrazine-1-carboxamide along with HL3 = (E)-2-(pyridin-2-ylmethylene) hydrazine-1-carboxamide. The created complexes were partitioned for their antibacterial actions in contradiction of bacterial species E. coli, K. pneumonia (Gram –) along with S. aureus, B. subtilis (Gram +) by smallest inhibitory (MIC) concentration and smallest bactericidal (MBC) concentration approaches. In vitro anticancer investigations of ligands and coordination complexes (1-3) by means of

MTT assay have been as well prepared. Consequences reveal that complexes (1-3) possess greater anticancer and antibacterial activities as compared with individual free ligands [23].



Scheme 10: Schematics depiction of complexes (1-3)

Formation of [Cu (L) Cl2] (1) and [Ni (L) Cl (H2O) 2)] Cl (2) complexes, where L= piperidin-2-yl-N-(1-(pyridin-2-yl) ethylidene) methanamine have been testified accompanied by their categorization as a result of spectroscopic methods. Diverse characterization methods with viscosity measurements, fluorescence spectroscopy and electronic absorption spectroscopy have been employed to investigate the binding interacting of 1 and 2 complexes with Calf thymus DNA (CT-DNA). The consequences have revealed that these complexes have ability to show potential DNA binding by intercalation alleyway. Investigation of antibacterial action by means of bacterial strain E. coli has shown that just the 1st complex have antiseptic features. In addition, ligands, metal as well as its complexes have been assessed independently for cell feasibility investigations throughout MTT evaluation of HeLa cells. Cell feasibility is found to be raised as time increases for entire systems exemplifying biocompatible characteristics of ligands, metals in addition to their complexes. Accordingly, complex 1 has been concluded appropriate for advanced cell viability [24].



Scheme 11: Synthetic pathway for ligand L

Conclusion

Schiff base stands for a branch of chemistry which is constantly investigated by scholars. Its ligands stand for advantaged items for the reason that they are straightforwardly organized as a result of a uncomplicated one-pot condensation of the aldehyde and prime amines. Those metal complexes and compounds have an assortment of medical, methodical and industrial uses. Correspondingly, they have imperative parts in catalysts. In this study, the organic activities of SB and its complexes were briefed from 2014-2019.

References

1. S Dayagi, Y Degani (1970) Wiley Inter science, New York, 71: 221
2. Zainab Hussain, Emad Yousif Ahmed Ahmed Ali Altaie (2014) Org. and Med. Chem. Lett., 1: 4.
3. B J Gangani, P H Parsania (2007) Spectroscopy Letters., 40:112.
4. VH Prent, HJ Haupt, F Huber, R Cafalu, R Barbieri (1997) J. Meter. Chem., 7: 923
5. Hai Jain Yang, Wen Hua, Sun Zi Long, Li Zhi Ma (2002) Chinese. Chem. Lett., 13: 6.
6. KS Siddique, S Tabassm, SAA Ziadi, RI Kureshy, NH Khan (1989) J. Indian. Chem. Soc., 28A: 1094.
7. Arulmurugan S, Kavitha HP, Venkatraman BR (2010) Rasayan J Chem., 3: 385-410.
8. Peter Otto, János Ladik, Koloman Laki, Albert Szent-Györgyi (1978) Proceedings of the National Academy of Sciences of the United States of America, 75 (8): 3548-3550
9. S Arulmurugan, Helen P Kavitha, BR Venkatraman (2010) Rasyan Journal of Chemistry, 3 (3): 385-410.
10. ML Sundararajan, T Jeyakumar, J Anandakumaran, B Karpanai (2014) Selvan; Spectrochimica Acta Part A: Molecular and Bio molecular pectroscopy, 131: 82-93.
11. Emad Yousif, Ahmed Majeed, Khulood Al-Sammarrae, Nadia Salih, Jumat Salimon, Bashar Abdullah (2014) Arabian Journal of Chemistry.
12. T Mangamamba, 1 MC Ganorkar, 1 G Swarnabala (2014) International Journal of Inorganic Chemistry, Article ID 736538, 22.
13. Sahar Shaygan, Hoda Pasdar, Naser Foroughifar, Mehran Davallo, Fereshteh Motiee (2018) Appl. Sci., 8(85):1-12.
14. Amit Kumar Gautam, Arun Kumar, Kaushlendra Sharma, BK Rai (2016) Oriental journal of chemistry, 32: 2.
15. Farhana Afsan, Sadia Afrin Dalia, Saddam Hossain, Shaheen Sarker, Kudrat-E-Zahan (2018) Asian Journal of Chemical Sciences, 4(3): 1-19.
16. Teng-Jin Khoo, Mohammed Khaled bin Break, KA Crouse, M Ibrahim M Tahir, AM Ali, AR Cowley, DJ Watkin, MTH Tarafder (2014) Inorganica Chimica Acta, 413: 68-76.
17. Wail Al Zoubi, Abbas Ali Salih Al-Hamdani, Susan Duraid Ahmed, Young Gun Ko (2017) Journal Physical Organic Chemstry, 1-13.
18. Lekaa K Abdul Karem, Fawzi Y Waddai (2018) Journal of Global Pharma Technology, 10(08):201-208.
19. LK Abdul Karem1, RK Rahem 1al-Shemary, MT Tawfiq (2018) Journal of Global Pharma Technology, 10(06):107-116.
20. Rehab Kadhem Rahem Al-Shemary, Lekaa Khalid Abdul Karem, Faaza Haseen Ghanim (2018) Oriental Journal of Chemistry, 34 (2): 1105-1113.
21. Saba H Mahdi, Lekaa K Abdul Karem (2018) Oriental Journal of Chemistry, 34(3):1565-1572.
22. L K Abdul Karem, F H Ganim, RK Rahem Al-Shemary (2018) Biochem. Cell. Arch., 18 (1):1437-1448.
23. Roghayeh Fekri, Mehdi Salehi, Asadollah Asadi, Maciej Kubicki (2019) Inorganica Chimica Acta, 484 (1): 245-254.
24. Kalyanmoy Janaa, Somnath Dasb, Horst Puschmannc, Subhas Chandra Debnatha, Aparna Shuklad, Arun K Mahantad, Maidul Hossainb, Tithi Maitye, Bidhan Chandra Samanta (2019) Inorganica Chimica Acta, 487 (1):128-137.

