Applications of biological of Azo-Schiff base ligand and its metal complexes and: A review

Lamia S. Ashoor[1], Rawa'a Abass Majeed[2] and Rehab Kadhim Raheem Al-Shemary[3]*

[1]*Department of Basic science , Collage of Agriculture Engineering sciences Baghdad University.*

[2]*Department of Basic science ,Collage of Agriculture Engineering sciences Baghdad University.*

[3] *Department of Chemistry, College of Education for Pure Science Ibn Al-Hatham, Baghdad University.*

[*]*Corresponding Author:* drrehabalshemary@gmail.com

Received 05-11-2020, Accepted 16-03-2021, published 14-04-2021.

DOI: 10.52113/2/08.01.2021/74-90

Abstract: 1998 onwards, a span reporting 1000s of studies depicts the ever-increasing Schiff bases and their complexes applicability; this study genetically tests the research of the last 20 years. The variety of these molecules structural has made them obtainable for a so broad ambit for implementations of biological. They are eminent and because of this unique feature they find their position in the quantitative and qualitative calculation of metals in the aqueous medium. It demonstrated to be prominent catalysts and showed an enjoyable effect of fluorescence. Definitively, Schiff base fissures gotten situation of a unique during bio-experiments and in vitro to develop drugs with a large number of biological structures containing parasites, fungi, viruses, cancer cells, bacteria, etc.

***Keywords*:** Azo-Schiff base, Metal complexes, Biological application

Introduction

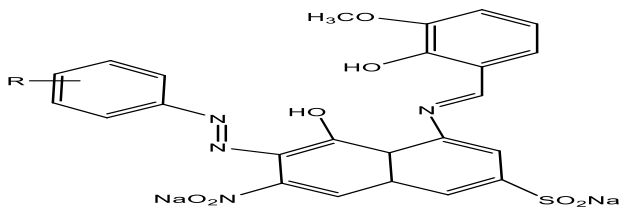
Even Hugo Schiff might not realize while publishing the results of his study as communication of scientific about 155 years ago that these components of organic would be made a separate field of great attention not only in chemistry but also in other scientific fields containing biological, materials, engineering and physical[1]. Merely, they may be called as the outputs of chemical reaction of a ketone or an aldehyde with an elementary amine under a specified conditions set [2]. Structurally, O of (C═O) functionality in a ketone or/and an aldehyde is substituted with N which due to the aniline or azomethine or imine (C═N) functionality formation with the molecule release of H_2O that is their property[3]. There has been a significant increase in the research of Schiff bases coordination to the metals in addition to the major set metals and the organic metal of the major set

[4]. The aforesaid derivatives of metallic of Schiff bases have displayed a wealthy variety of structural motifs depended upon chelating capacity of the ligand under realization Schiff bases and their metallic derivatives have given applicability of outstanding in systems of biological acting as bacteriostatic antifungal[5], antibacterial, antitubercular[6], antitumor antiviral, insecticidal,[7] analgesic, antipyretic[8], anti-inflammatory, and in vitro cytotoxic agents to the linkage fashioning of lysine with Schiff and alteration in the electrical possibility of membrane with ultimate transition of signal to brain[9]. These compounds had been applied for industrial targets like extraction of liquid–liquid, catalysts, pigments, intermediates, efficient transport, in synthesis of organic and as stabilizers of polymer [10]. Schiff bases are worthily utilized to monitor dangerous substances in the environment. e.g., Cr^{3+} and organophosphates were quantified, identified in ecological specimens, and extracted with precision and high accuracy [11]. Furthermore, Schiff bases applications of a biological and their derivative of metallics, e.g, in treatment of mechano-chemical chemistry of polymer, under investigation often due to the polymer destruction [12]. Azo compounds are a very important class of chemical compounds receiving attention in scientific research. They are highly colored and have been used as dyes and pigments for a long time. Their reaction is responsible for visual procedure in animals; the process starts with retinaldehyde excitation resulting techniques of electroanalytical are very useful in studying samples of environmental, clinical and laboratory due to they are so are economical and versatile; Schiff bases are recognized as ion carriers and when they are synthesized with polymers of organic they may be converted into films as sensors to measure the selective potential of the ions[13-14]. During the past two decades, major awareness has been paid to the chemistry of the transition metal complexes of Schiff bases including N and other donors[15]. Thus, it plays an important role in revealing the preferred coordination geometry of mineral complexes due to its preparative accessibility, versatility and structural diversity [16]. Consequently, they have a substantial role in detecting the chose geometries of chelation of metal complexes attributed to their variability and structural diversity and precursory accessibility[17].These features of compounds have produced in board enforcements in the area of biological complexes of Cu (II) are recognized to be efficacious with arthritis of rheumatoid and they also appeared efficiency of antiulcer [18] .This is due to irritation of gastrointestinal often prevents therapy by other drugs of antiarthritic. This is due to role of Cu in restraining damage of gastrointestinal using acidic anti - inflammatory. They have been applied in industry as dyes [19]. Also, they are applied in chemistry in pH of analytical as titration of complexometric, redox, or indicators. They are an attention materials which have appeared a reign of enforcements containing; textile industry, dyeing, analytical chemistry, food technology, and/or pharmaceutical application

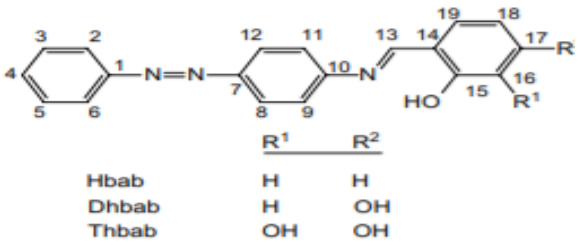
[20]. The efficacy of biological for azo-components allowed them to be applied in the remedy of textile materials, and they are recognized for their significance of medicinal and have appeared a set of implementations as antibacterial, antitumor, antineoplastics and antiseptics. However, relatively less work has been done on heterocyclic azo linked Schiff bases [21].

1.1 Literatures survey

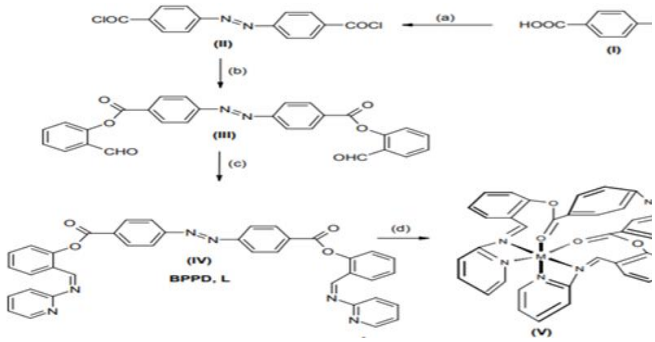
In 2005 compounds of Diazo were synthesized by coupling of mono sodium salt of 4 -amino-5-hydroxy-2,7-naphthalenedisulfonic acid with benzenediazonium chloride ions under conditions of alkaline, and H_2L_1 and H_2L were then gotten by the condensation of o-vanillin with 4-amino5-hydroxy-6-(2-nitrophenylazo)-2,7-naphthalenedisulfonic acid di disodium salt and disodium salt of 4-amino-5-hydroxy-6-(2,5-dicholorophenylazo)- 2,7-naphthalene disulfonic acid. Complexes of Ni(II) ,Co(II) and Cu(II) were synthesized then describe by spectroscopy , elemental analyses,. In DMSO-d_6 solutions, it was found that the ligands are with their coinciding and mightily dominating hydrazone tautomers in equilibrium. The outcomes indicated that condensation of the o-vanillin and compounds of azo-vanillin derivative in a molar proportion (1: 1) created mono-nuclear Schiff base bonds with an ONO donor group[7].



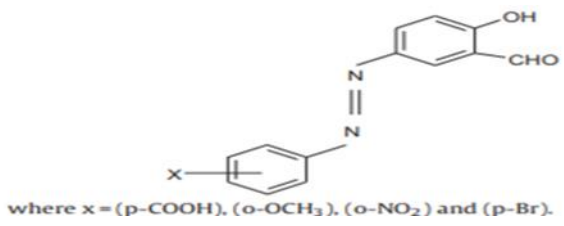
In 2009 Esin _ Ispir [9]was notified three novel Schiff bases including 3-((E)-(4-((E)-phenyldiazenyl) phenylimino)methyl) benzene-1,2-diol 4-((E)- (4-((E)-phenyldiazenyl) phenylimino)methyl)benzene-1,2,3-triol and 2-((E)-(4-((E)-phenyldiazenyl)phenylimino) methyl)phenol, and as the group of azo were prepared from the reaction of with 2,4-dihydroxybenzaldehyde2,3,4-trihydroxy benzaldehyde,salicylaldehyde and,,p-amino azobenzene respectively. The mononuclear complexes of Cu(II) and Co(II) were synthesized and characterized using measurements of conductance and elemental analyses, and spectroscopy. The complexes of Cu(II) and Co(II) are made by the chelation of the atoms of O and N of the ligands. The characteristics of electrochemical of the metal complexes in DMSO were scrutinized at 100 mV s1 scan rate; the characteristics of oxidative coupling of C–C of the complexes of Cu(II) and Co(II) were scrutinized on the sterically hindered 2,6-di-tert-butylphenol. Also, the compounds were estimated for both their efficacy of antibacterial in vitro applying the way of disc diffusion.



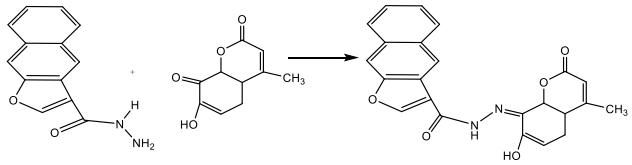
In 2010 Complexes of heterocyclic ligand was namely bis(2-(pyridin-2-ylimino)phenyl)-4,4'-(diazene-1,2- diyl)dibenzoate with ions , Ni(II), Co(II), Zn(II) and Cu(II) have been prepared and described through Macro-analysis. The compounds have been tested for the antifungal efficiencies towards fungi Candida albicans and Aspergillus niger and biological efficiencies towards bacteria *Escherichia coli (-) gram and Staphylococcus aureus (+) gram*. The outcomes appeared which the complexes have more efficiencies of biological than the ligand. The arrangement antimicrobial efficiencies was Cu(II) > Zn(II) >Ni(II) >Co(II) >L[10].



In 2011 Ibrahim S Ahmed [11], were prepared novel dyes of azo-azomethine by reaction of o-nitroaniline,salicylaldehyde with p-bromoaniline, o-anisidine, ,and p-aminobenzoic acid to form compounds of azo and also condensation by urea to made derivatives of 4-(R-arylazo 2-salicylaldene)-urea azo-azomethine. The Hg(II) Zn(II), Cu(II), and Ag(I), complexes of these ligands were synthesized. The compounds structure were described by applying spectra. The constant of stability for the complexes ligands and the constants of proton dissociation and have been calculated potentiometrically in media of water-alcohol (v/v) 40% then the complexes stoichiometry were calculated conductometrically. The values detect that the complexes stoichiometries were synthesized in (1:2) and (1:1) (M:L) molar proportions. The complexes natures of nonelectrolytic and electrolytic were designated on measurements of molar conductance. The analyses differential thermal (DTA) and thermogravimetric (TG) were studied with rate of heating 10°C/min in nitrogen atmosphere. The parameters of thermodynamic and kinetic complexes for thermal decomposition have been determined by way of graphical applying way of Coats-Redfern (CR).



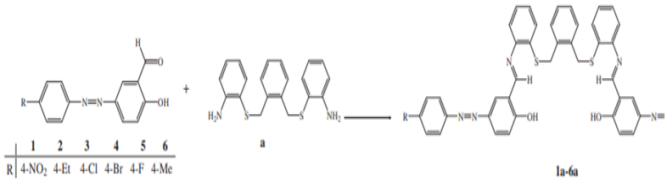
In 2012 M.B. Halli, and et al[12] have been prepared the complexes of kind ML_2, where M = Cd(II), Cu(II), Ni(II),Co(II),Zn(II), Hg(II), and L = Schiff's base derived from 8-formyl-7-hydroxy-4-methyl coumarin with naphthofuran-2-carbohydrazide. The coordination of the complexes have been illustrated in spectral values, thermal, ESR, and magnetic and the light of analytical studies. The values of molar conductance mention which the complexes are nature of non-electrolytic. The redox conduct of one of the synthesized complexes was inspected by voltammetry of cyclic. The synthesized compounds have been tested for their efficiencies of antifungal and antibacterial in vitro by MIC way. Then, the ligand with its complexes has been tested for their antioxidant efficacy.



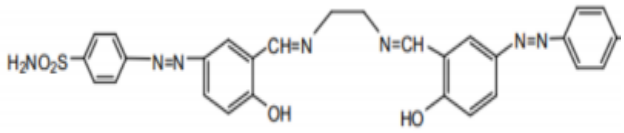
In 2012 Raziyeh Arab Ahmadi and Saeid Amani[13], were prepared ligands of azo moiety-including Schiff bas. The ligands were characterized by thermogravimetric analysis, elemental analysis and spectroscopy. Next the conforming Co(II) and Cu(II) complexes were prepared and described by the ways of spectroscopic and physicochemical and analysis. The room temperature efficient moments of magnetic for complexes are 1.56, 1.45, 2.16, 2.80, 1.62, and 2.26 B.M. for complexes (3a-3c), and (4a-4c) respectively, mentioning which the complexes are paramagnetic with great communication of electronic between the two centers of metal .

In 2012 H. Khanmohammadi, K. Rezaeian [14]have been synthesized novel dyes of azo-azomethine via reaction of substituted azo-coupled salicylaldehyde with a, a - bis(o-aminophenylthio)-1,2-xylene. The dyes have been characterized by elemental analysis ,

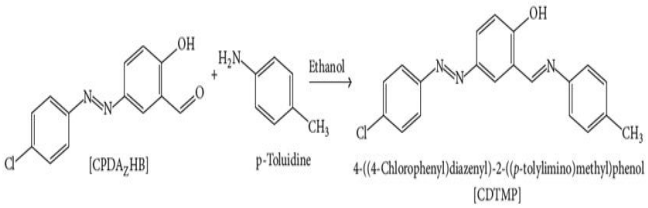
spectroscopic ways using to determine The dyes thermal conduct. Furthermore, it was studied the solvents effect of organic on the UV–Vis spectra of the dyes with different polarities.



In 2013 Hoda A. Bayoumi[15] , was synthesized the dibasic ligand of Schiff base type N_2O_2 namly (N,N'–bis(5–(4–sulfanilamidophenylazosalicylidene)–ethylenediamine) in ethanol by the.condensation of [5–(4–sulfanilamido phenylazosalicylaldehyde] with ethylenediamine Complexes with Co(II), Cu(II), Cr(III) Ni(II), and ions are prepared. Analyses are applied to clarify the structure of the recently prepared metal complexes. In metal chelates of (M:L)1:1, the Schiff base behave as a ligand of di–negative N_2O_2 tetradentate. The parameters of kinetic for the stags of decomposition have been determined applying way of Broido.



In 2013 C. Anitha, and elat[16] , Mn(II), VO(II), Zn(II), Co(II), Cu(II), and Ni(II) Azo Schiff base complexes have been prepared from 4-((4-chlorophenyl)diazenyl)-2-((*p*-tolylimino) methyl) phenol. The advantages of structural and the bonding nature of the complexes have been concluded from spectral and other analytical studies. They are detect system of square-pyramidal for VO, system of square-planar for Cu, and system of octahedral for other complexes. The Cu (II) EPR spectra in DMSO of complex at 77 K and 300 K were registered and its salient advantages are notified. Studies of Antimicrobial with some bacteria suggest that the complexes are greater potent fungicides and bactericides than the ligand. The conduct of electrochemical of the Cu(II) complex was tested by cyclic voltammetry. All the compounds may avail as materials of potential photoactive as suggested from their characteristics of fluorescence. The second conversion of harmonic capacity of the ligand was found to be more than that of KDP and urea. Cu(II) SEM image displays the surface morphology and crystalline state of the complex.

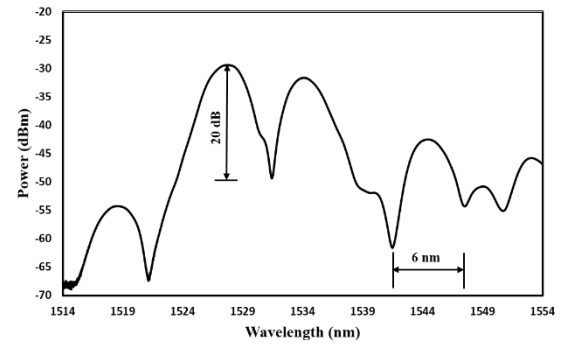


$$f(x) = \frac{x^2}{3} \ldots + \frac{x^8}{9} \qquad (1)$$

Fig. (1): Optical spectrum.

1. Methodology (Experimental Procedure)

Figure (1) shows the optical spectrum.

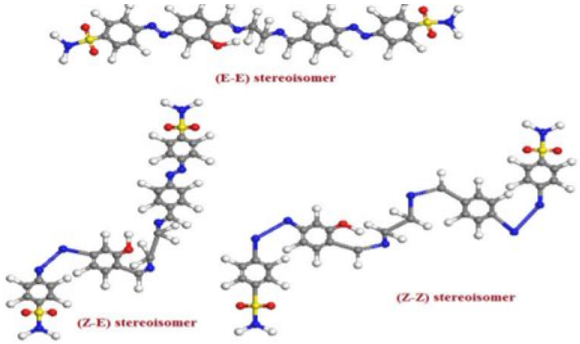


2. Results and Discussion

3. Conclusion

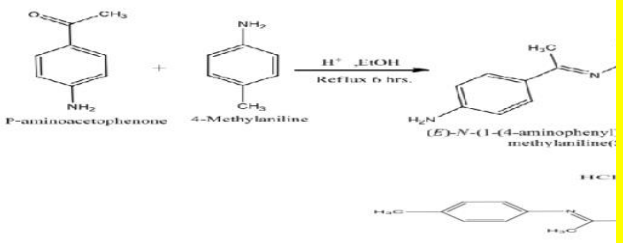
Tables must insert after the conclusion section. We prefer to put it within the column. If necessary you can maximize

In 2014 A.M.A. Alaghaz[17], were synthesized mononuclear complexes of Mn(II), Fe(III), Cr(III), Ni(II), Co(II), Zn(II), Cu(II), Pt(IV) and Cd(II) of ligand of Azo-dye Schiff's base and calculated by various techniques of physical. All the complexes are studied utilizing magnetic susceptibility, molar conductance, elemental and thermal analysis and spectral studies. All complexes were kind of the high-spin and gave to have 6-chelat with octahedral system unless the Cu(II) complex that was 4-chelat with square planar system. The measurements of molar conductance of all the complexes coincide to nature of nonelectrolytic in solution of DMF. Determents of quantum chemical were carried out with way of semi-empirical to give the optimum system of the compounds. the ligand and the complexes (II/III/IV) geometries in modeling of molecular were totally optimized with observance to the energy utilizing the set of 6-31G basis. Also these compounds have been tested for their efficacies of antimicrobial in vitro.

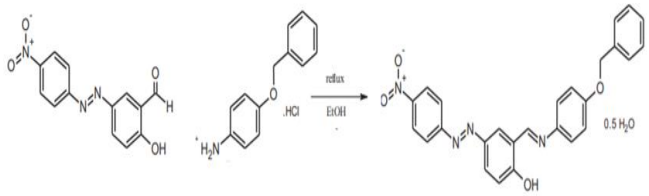


In 2014 Raheem T. Mahdi and elat [18],were synthesized new heterocyclic ligand of Schiff azo (E)-N-(1-(4-((E)-(4,8-diphenyl-1H- imidazol-2-yl) diazenyl) phenyl) ethylidene)-4-methylaniline with Cu(II), Hg(II), Zn(II) Ni(II) Co(II) Cd(II) metal ions in complexes. This ligand was prepared and described by analysis and spectra and its complexes were described by magnetic moment, molar conductivity and flame absorption of atomic. Relying upon all outcomes was suggested system of octahedral for the complexes. It was gave which the ligand conducts as a (N,N′) bidentate ligand neutral

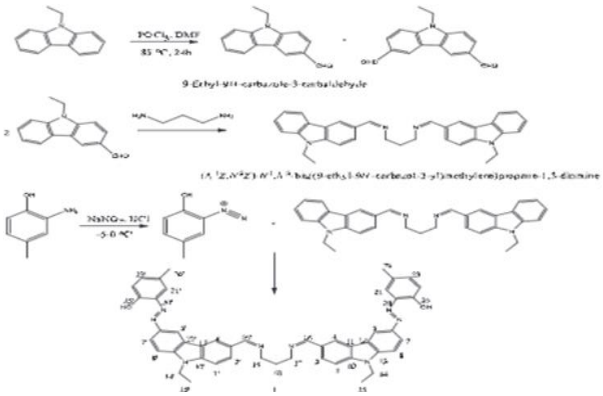
composition coordinates with stoichiometry(metal: ligand) (1: 2)



In 2014 Mustafa Bal [19],was substituted a new (mbH) ligand was synthesized in solution of ethyl alcohol from 4-benzyloxyanilinehydrochloride and 2-hydroxy-5-[(4-nitrophenyl)diazenyl]benzaldehyde. These Mn(II), Ni(II), Zn(II) Co(II), and Cu(II) mononuclear complexes of the ligand were synthesized and their compositions were proposed by elemental analysis, and spectroscopy of the mbH ligand was registered. The ligand mbH of azo-azomethine, conducts as a bidentate ligand chelating through the O atom of the phenolic moiety and the N atom of the (–CH=N–). Analyses of Elemental specified that the proportion of ligand: metal was 2: 1 in the metal coordinates. Parameters of Powder X-ray diffraction proposed a system of monoclinic for the ligand mbH and its complexes of Cu(II), Ni(II), Zn(II) and Co(II), and a system of orthorhombic for the Mn(II) complex. Features of electrochemical of the compounds were carried out in the zone 200 250, and 500 mV s^{-1} scan rates of solvent in 1×10^{-3} –1×10^{-4} M DMF and CH_3 CN,. The ligand appeared both processes of irreversible and reversible at these rates of scan. Also, features of genotoxic of the compounds were tested.

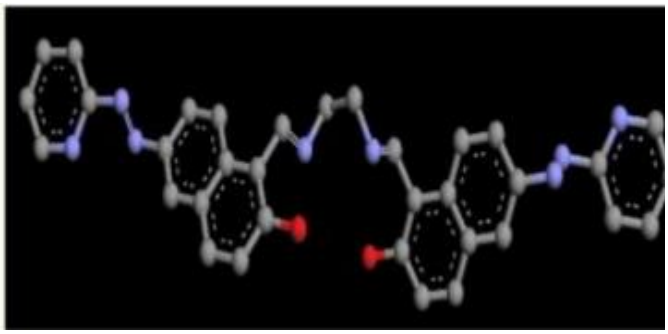


In 2015 Selma Bal [20],was study the prepation of a new compound of azo-Schiff base, derived from condensation between 1,3-diaminopropane and N-ethylcarbazole-3-carbaldehyde obeyed by reaction of the diazonium salt of 2-amino-4-methyl phenol with azo coupling. The recently prepared ligand was moreover reacted with the ACO salts of Cu, Co and Ni to compounds of 3-coordination. All prepared compounds have been described through analysis of spectral. The compounds of chelation have been tested for their catalytic and thermal features. Yields of moderate and good were given for cyclohexene and the styrene oxidation. Features of thermal of the compounds have been elucidated and the outcomes given have sup-ported the suggested systems.

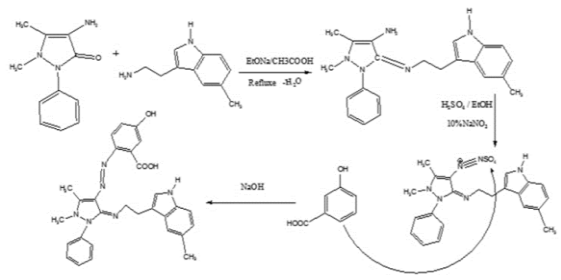


In 2015 Suchithra R[21], was study the complexes of Ru(III) having public formulation [Ru(L)Cl(PPh_3) where L= azo Schiff base derived from ethylene diamine vanillin / 2-aminopyridine, and 2-hydroxy naphthaldehyde have been synthesised. The compounds have been depicted by molar conductance, spectroscopy data and magnetic sensitivity. The

ligand represents as a tetradentate and chelating to Ru through N of (C=N) and O atoms of phenolic. A system octahedral has been proposed for the complexes based on studies of magnetic sensitivity and UV-Vis spectra. Low data of molar conductance detected the complexes kind of non-electrolytic. The complexes have been tested for efficacies of anticancer and antimicrobial



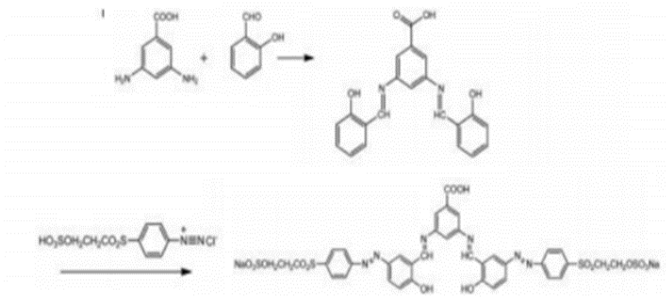
In 2015 Abbas Ali and elat[22], The ability of chelation of Pt(II) Co(II), Pd(II) Cu(II), and Ni(II), ions has been proven in reactions of complexation with the azo-Schiff base. The compounds were depicted applying elemental analysis, calculation of spectra spectra and analysis.The outcomes confirmed the coordination of the ligand through the azomethine nitrogen, the carboxylate ion and azo group (Azo) with ions of the metal. The parameters of activation thermodynamic, like ΔG*,,ΔE*, ΔH*, K and ΔS* are determined from the curves of TGA applying way of Coats–Redfern. The compounds were tested for their efficacy of biological with species of bacterial, 2 Gram (-) bacteria and 2 Gram (+) bacteria .



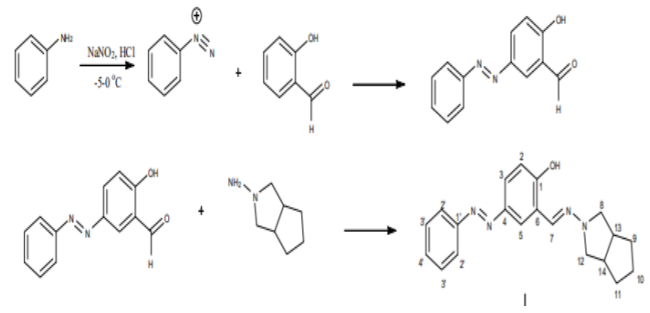
In 2015 ligands (L^1H), (L^2H) including a –N=N– moiety, and their complexes were prepared. They were applied as catalysts for the fixation of chemical for CO_2 into carbonates of cyclic applying epoxides that were utilized as both solvent and substrate. Corresponding data of IR and UV and analytical the complexes are made by chelation of the ligands atoms of O and N and the M: L proportion was got to be 2:1 for all the complexes. The results of DTA and TG appeared that these complexes had good constancy of thermal. The molecular structures for ligand **2** (L^1H) and ($Zn(L^1)_2$) complex were calculated by studies X-ray diffraction. After studies of optimization and selecting the greater efficient catalyst ($Zn(L^1)_2$,), were completed by shifting different parameters of ionic liquids have been given to have a effect (+) and appeared the higher efficient performance with (bmim)PF_6 + $Zn(L^1)_2$ (**4**) as a system of binary catalytic[23].

In 2015 Kai Zhang[24],was synthesized A novel ligand of azo Schiff base including reactive groups of crosslinking (BHSABA) , (A) , and its complexes with Cu^{2+}, Co^{2+} and Mn^{2+} described by l analysis, spectroscopy. Two groups of reactive of p-[(20 -sulphatoethyl) sulphonyl were capable to made bonds of covalent with biomass, like chitosan ,cellulose and so on, to get material of functional. The efficacy of catalytic for the compounds for decomposition of H_2O_2 were tested. The outcomes appear that the spectra of fluorescence of Mn2A and Co2A complexes had raised fluorescence phenomena. They had strong efficacy of catalytic for H_2O_2 decomposition. When the concentration was 5 mg/l of complex Mn2A, decomposition of H_2O_2 almost done at 40C in 40 min. The catalytic efficacy arrangement of 3 complexes for H_2O_2 decomposition was Cu2A<Co2A< Mn2A. These complexes with moieties of reactionary have

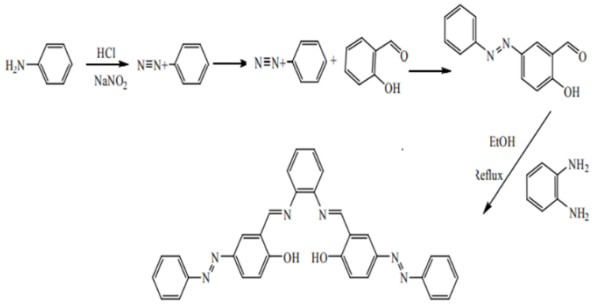
enforcement of potential in the decomposition of H2O2 of fields of water handling



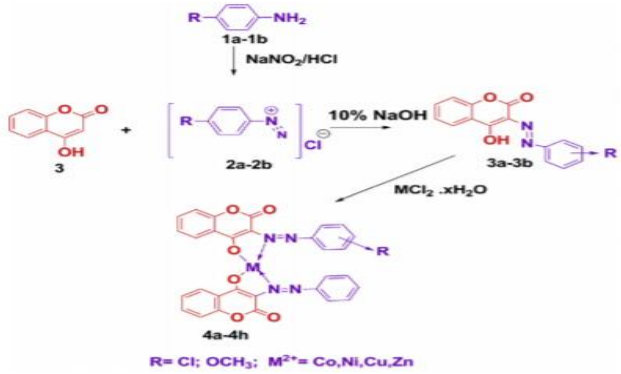
In 2016 Selma B[25], was prepared a novel azo-Schiff base applying salicylaldehyde, aniline and 3-amino-3-azabicyclo[3.3.0]octane hydrochloride. The ligand were reacted with of Ni (II) Co (II), and Cu (II) acetate salts. The compounds were described applying techniques of spectral. Complexes gave moderate/good outcomes in the oxidation reactions of cyclohexene and styrene as catalysts. Efficacies of antimicrobial for the compounds appeared good suppressor influences on a number of bacteria Gram(+) and Gram(-).



In 2017 Zuhria Salem [26] synthesis of ligand H_2L were investigated by the condensation of 2-Hydroxy -5- (phenyldiazenyl)benzaldehyde with phenyl -1,2-diamine. Ligand reaction with ions of Ni (II), Co (II) and Cu (II) were investigated by applying salts of MCl_2 by the molar ratio 1:1. 3 complexes were gotten, the Ni (II) and Cu (II), are tetracoordinate linking to two O-phenolic and two N- imine in convergent system of square planar. Also Co (II) complexes applying the same positions such as other metals but obtained octahedral system.

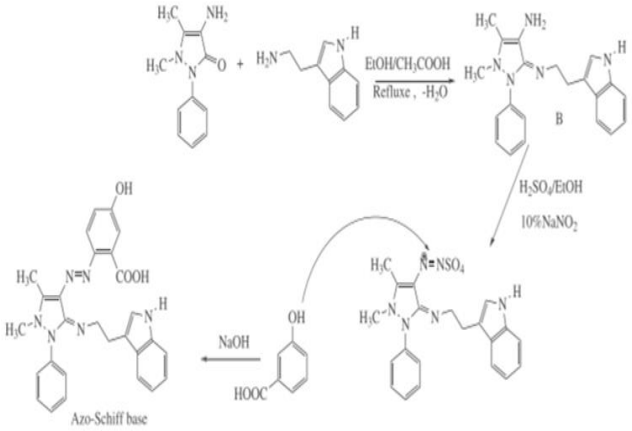


In2017 synthesized new complexes derived from analogues of 3-aryl-azo-4-hydroxy coumarin were completed by mixing a hydro-alcoholic solution of analogues of 3-aryl-azo-4-hydroxy coumarin with metal chlorides. The structural media of the molecules was described applying various instrumental ways. The efficacy of antimicrobial of the compounds was calculated by way of the agar well diffusion. The Co complexes of (HL_1) and (HL_2) appeared superior efficacies of antimicrobial.The antimicrobial investigation appeared that the Co complexes of these analogues displayed antimicrobial efficacy that was stronger than the ligands[27].



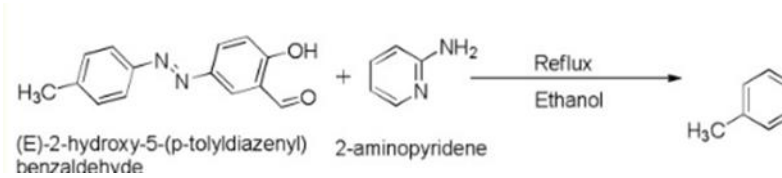
In 2017 Wail Al Zoubi, [28] was prepared a ligand by reaction of (Schiff base B) with m-hydroxy benzoic acid. This ligand was applied for complexation with Ni(II), Co(II), Pd(II) and Pt(IV) ions. These compounds were described by spectroscopy, elemental analysis. The activation

thermodynamic parameters, such as K, ΔH* ΔE*, ΔG* and ΔS*, are calculated from the TGA curves applying Coats-Redfern way. The activities biological in vitro of compounds had been screened with bacteria, two Gram (+) and two Gram (-).

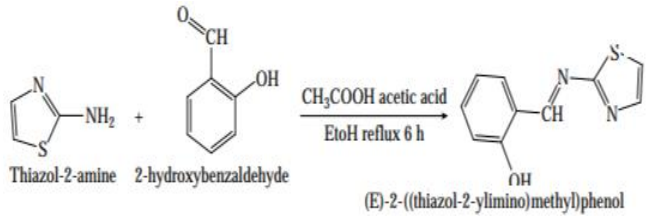


In 2018 Ahmed K. Hu [29]were prepared and described of mixed azo- Schiff-base and DTCs ligands and complexes. The ligand by the mixing of 2-amino-phenolein with naphthyl amine diazonium salt a mole ratio 1:1. The DTCs was isolated by the reaction in potassium hydroxide of carbon disulphide with 2 NH. The complexes were prepared by mixing the azo-linked Schiff-base ligand and DTCs ligand with the metal salts. Compounds were described by analytical and spectroscopic that indicated complexes demonstrated four and six coordinate structures in the solid and solution state. Compounds efficacy of biological were tested for their activity of antimicrobial with 4 species of bacterial Grams - ve, and + ve

In 2018 Mohammad A., Saud I. Al-Resayes[30], are studied a new ligand and its complexes with ions Fe(III) and Cu(II). The compounds are characterized by techniques of physico-chemical. Also, the compounds were tested for antimicrobial activity with strains of fungal and bacterial by measuring, (MIC) , inhibition zone and (MBC). The complexes displayed moderate efficacy of antimicrobial when screened with bacterial Grams of +ve and −ve. to get insights into the DFT studies and ligand structure are registered. The outcomes gotten are Very close to the empirical outcomes. In addition, the chemical hardness, energy gap, electronegativity, electrophilic index softness, and chemical potential were determined applying energy value of LUMO, HOMO.

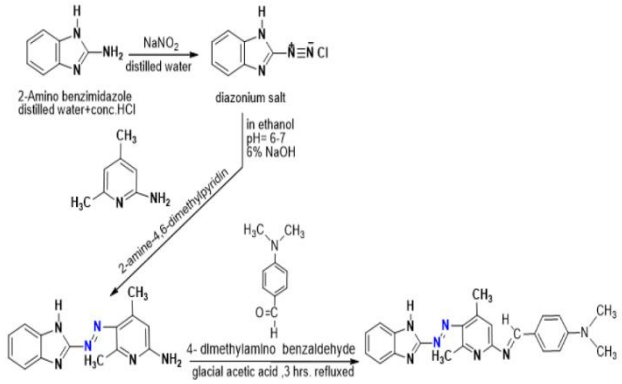


In2018 E. S. Mahdi , R.T. Mahdi Al-Sa'edi[31], were prepared the new azo Schiff-base ligand HL_1 by reacting chlorid salt applying the coupling of diazonium salt of 3-bromoaniline with (E)-2- (thiazol-2-ylimino) methyl phenol of with these metals of compounds, with general formula $[M(HL_1)_2](H_2O)$, M = Hg(II), Cd(II), and, Zn(II) and $[M(HL_1)_2](H_2O)_2$, M = Ni(II), Cu(II) ,Co(II)]. The compounds were characterized by obtainable ways of spectra and analytical. Results showed that complexes of metal had tetrahedral system , while Ni(II), Cu(II) and Co(II), chelate had octahedral system. The compounds was screened with the sensitive bacteria, including Pseudomonas aeruginosa and Staphylococcus aureus.

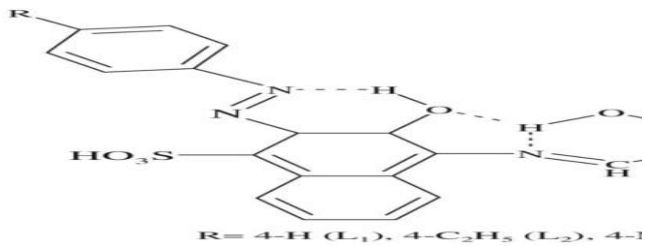


In2018 Khalid J. Al-Adilee [32], new dye have been prepared from a condactivat of (L_1) . A new metal complexes of azo- Schiff base . They were

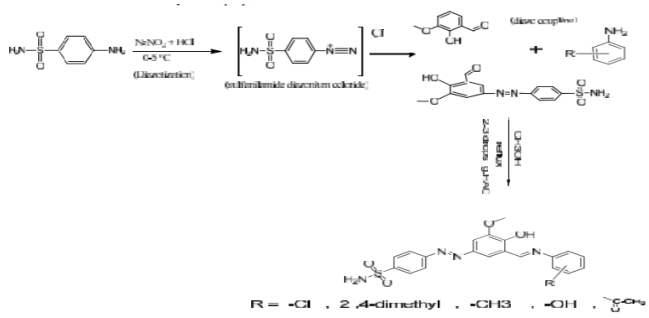
characterized by the spectroscopic and analytical ways and suggest the mole [M:L] ratio was [1:2] for ions of Pt(IV) and Ni(II). The efficacy of antibacterial for the compounds was studied with bacteria grams (+)and (-) gram , the efficacy of antifungal of the compounds with the fungi Alternaria. The Pd(II)-complex cytotoxicity on natural cells and human cancer were studied supplying MTT assay.



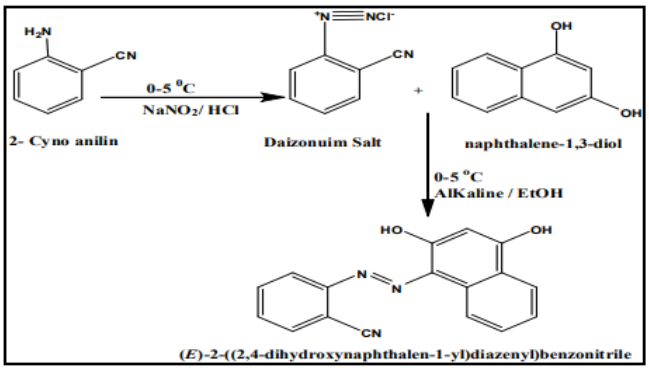
In 2018 Emin Erdem[33] azo compounds were prepared under alkaline conditions by 1-amino-2-hydroxy-4-naphthalene sulfonic acid with coupling of benzenediazonium chloride ions, and Schiff bases, L1–3 were then obtained by the condensation of 1-amino-2-hydroxy-3-(phenylazo)-4-naphthalene sulfonic acid and salicylaldehyde with 1-amino-2-hydroxy-3-(4-nitrophenylazo)-4-naphthalene sulfonic acid 1-amino-2-hydroxy-3-(4-ethylphenylazo)-4-naphthalene sulfonic acid, and. New Zn(II), Co(II), and Ni(II), complexes of the ligands were synthesized and described by ways of thermogravimetric analysis and spectroscopic.



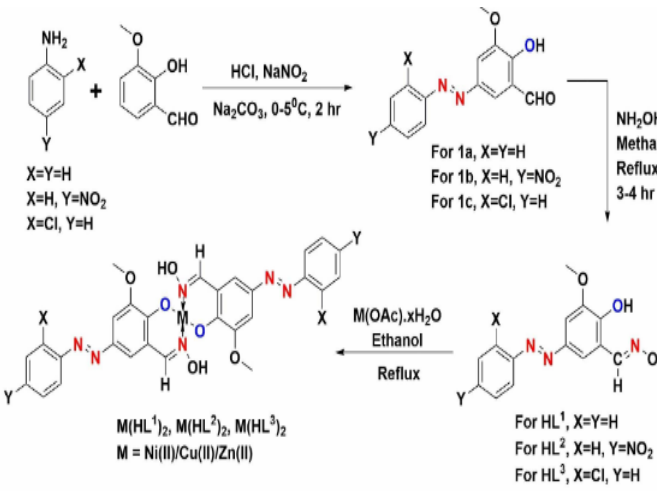
In 2019 Hala S Al-Atbi , and co authors [34], A chain compounds of azo-azomethine have been prepared by condensation reaction of aniline derivatives and 4-((3-formyl-4-hydroxy-5-methoxyphenyl)diazenyl) enzenesulfonamide. The new ligand was prepared in alkaline medium from sulfanilamide by coupling reaction with 2-hydroxy-3-methoxybenzaldehyde. The structures of synthesized ligands have been established based on their spectral data and analysis. The efficacy of biological of ligands have been screened by fungi and bacteria.



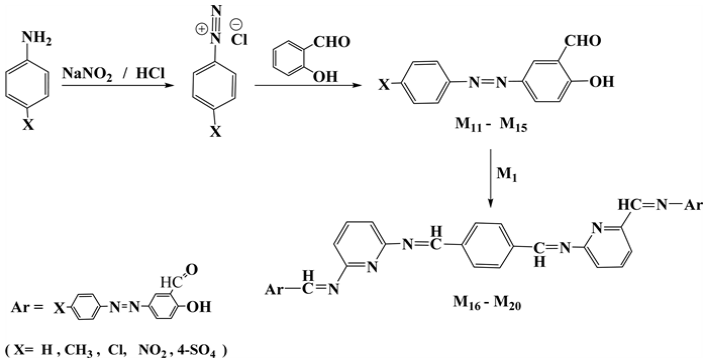
In 2019 Widad Ibrahem Yahya [35]a new azo compounds is synthesized by coupling of 1,3-dihydroxynaphthalene with (2- Cyano aniline). The azo ligand and complexes were specified by: spectra and elemental analysis. The complexes system were proposed based on analytical and spectral data. The ligand is coordinated to the metal ions with and N donor sites of O -(OH) and N- azo, in octahedral geometry. And valuation of biological of components appears efficiency with Candida albicans.



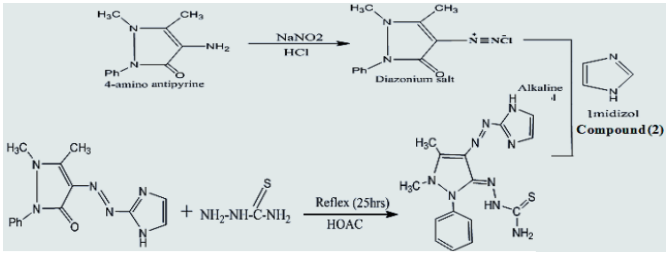
In 2019 a natural route of synthetic was reported for the synthesis of azo oxime depended ligands and their Zn(II) Cu(II) and Ni(II), complexes. The ligand (HL_1) was synthesized by condensing in the 1:1 molar ratio. Hydroxyl amine hydrochloride and 2 - hydroxy - 3 - methoxy - 5 - (phenyldiazenyl)benzaldehyde. Ligands chloro and nitro substituted of (HL_2) and (HL_3) respectively, were also prepared by the similar way. The complexes of Ni(II), Cu(II) and Zn(II) have been prepared by using ligands that were described by diverse techniques of analysis. They were tested for their activities of in vitro antioxidant and antibacterial. Ligands shows good antibacterial activity and it raises uncommonly after metal complexetion with MIC for Zn(II) complexes with bacteria grams of (+) and (-). Ligands appearing good antioxidant feature that is similar to that of kind of ascorbic acid antioxidant[35].



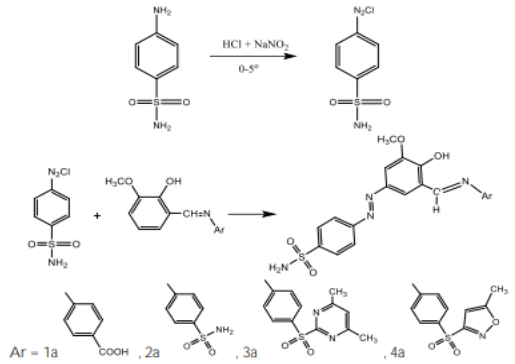
2019 Taha, N. [36]were prepared new tetra Schiff bases (M_2- M_9) in synthesizer of microwave by the condensation of various amines of aromatic and bis-Schiff base in moderate yields. And novel azo-Schiff bases were synthesized by the reaction of the with azo-salicylaldehyde (M_1) utilizing the similar way. The eco-friendly prepared by irradiation of microwave was selected as route attributed to its newly, competence, solvent time, cleanliness and saving characteristics compared with the traditional ways that lack these features; like wasting the polluted medium of solvents of organic and time consume to realize the same activity in preparation. The components that are supposed by us to be specialized in systems as photosensitizers of photochemical were specified by spectroscopy.



In 2020 Layla Ali. Mohammed and co-worker[37] has been synthesized a ligand of Schiff base from thio semicarbazaide with [(4 - ((1-H-imidazol-2-yldiazenyl)-1,5-dimethyl-2-phenyl-1Hpyrazol3(2H)-one)]. The complexes formula are $[M(L)]Cl_2$ Where. M= Zn(II) , Ni (II) ,Cu(II) and Co(II). The system structures of compounds were calculated through spectral, and analysis studies with a ratio of (1:1) (M:L). Constant of stability for complexes were calculated by ways of spectrophotometric. The binding energy (ΔE_b) and heat of formation (ΔH_f) for the metal complexes at 298 K were determined by PM3 way. Studies of biological efficacy of the compounds with bacteria Grams G(+ve) and G (- ve) and fungi . This may be due to the effect of compounds.

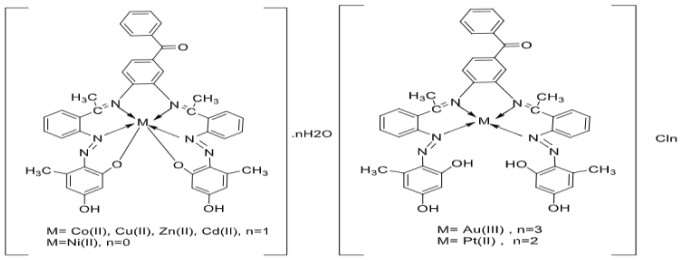


In 2020 were prepared four azo-Schiff base named (1a-4a) by diazotization reaction of the synthesized Schiff bases with sulfonamide compound. All new synthesized derivatives were identified by spectra. All compounds were tested for their antibacterial activity that showed good activity. The synthesized compounds were used as sensitive and selective analytical reagent for the spectrophotometric determination of cadmium (II). The composition of the Cd (II) complex is established as 1:2 by molar ratio and job methods. An excellent linearity with a correlation coefficient value is obtained for the complexes[38]



In2020 A. Shiliand co-author[39] Two new materials based donor acceptor modes, A and (B were Both (A and B) compounds have been prepared by reaction between N, N-Dimethyl-4,4'-azodianiline or/and 5-phenylthiophene-2-carbaldehyde with, 4-(4-nitrophenylazo)aniline . The Schiff bases A and B belong to the moiety of monoclinic $P2_1/c$ space. The prevalence of this interaction is explained by an analysis of the 3-dimensional Hirshfeld surface by plots of 2-dimensional fingerprint.

In 2020 M. A. Hadi and I. K.Kareem[40] were prepared the complexes of Ni(II), Co(II), Zn(II), Cu(II), Cd(II), Au(III) and Pt(II), from the complexation reaction between the ligand and metal Ions. This ligand was derived from the reaction of 3,4-diamino benzophenone, 2-amino acetophenone, and 3,5-dihydroxy toluene. The results of this studies show the coordination sites for the ligand with the metal ion were to be through O- OH, and the N-azomethine and the N-azo groups. The electronic spectral and magnetic measurement data predict octahedral structure of the complexes, except for Pt(II) and Au(III) complexes were suggested a square planar geometry. All complexes show that non electrolytes properties and no conductive species but Pt(II) and Au(III) complexes are electrolyte nature.



References

[1] Hossain, M. S., Banu, L. A. and E- Zahan,,M. K., Synthesis, characterization and biological activity studies of mixed ligand complexes with Schiff base and 2,2 ′-Bipyridine. Appl Sci Res Rev,2019,6:2394-9988.

[2] Slassi, A S, Tailler. F., Larcher, G., A. Amine, and El-Ghayoury, A., Imidazole and Azo-Based Schiff bases ligands as Highly Active Antifungal and Antioxidant Components: Heteroatom Chemistry, 2019, Article ID 6862170: 8

[3] Valarmathy, G., Subbalakshmi, R, Rengathan, R. and Kokila, R., Synthesis of Schiff base (E)-2-(((3-Hydroxyphenyl)imino)methyl)-6-methoxyphenol Containing N and O Donors

and its Metal Complexes: Spectral, Thermal, Redox Behaviour, Fluorescence Quenching, Antimicrobial and Anticancer Studies. Asian .J. chem,2018,30:645-650.

[4] Wankhede, B. S. ,and Patil, A. B.,Studies on Ti(III), Cr(III) and Fe(III), complexes with 1-(1-hydroxynaphthalen-2-yl) ethanone-4-chloro benzoylhdrazone ligand: Synthesis, Physicochemical and Antimicrobial activity. J. Phart, chem& Bio Scien, 2018, 6: 25-33.

[5] Tunçel, M.,and Serin, S. (2005): Synthesis and Characterization of Copper(II), Nickel(II) and Cobalt(II) Complexes with Azo-Linked Schiff Base Ligands, Synthesis and Reactivity in Inorganic, Metal-Organic, and NanoMetal Chemistry, 35:3, 203-212 To link to this article: http://dx.doi.org/10.1081/SIM-200037841

[6] Tunçel, M., Serin, S. Synthesis and characterization of new azo-linked Schiff bases and their cobalt(II), copper(II) and nickel(II) complexes. *Transition Met Chem* **31,** 805–812 (2006). https://doi.org/10.1007/s11243-006-0074-5

[7] Ispir, E., the synthesis, characterization, electrochemical character, catalytic and antimicrobial activity of novel, azo-containing Schiff bases and their metal complexes, Dyes and Pigments 82 (2009) 13–19

[8] Ram K.and Chaudhary, P, .Biological studies of a novel azo based Heterocyclic Schiff base and its transition metal complexes Hemant Der Chemica Sinica, 2010, 1 (2): 55-61 ISSN: 0976-8505 CODEN (USA) CSHIA5 55 Pelagia Research Library

[9] Ahmed , I. S. , Moustafa, M. M , Abd El Aziz M. M, Mono and Binuclear Ag(I), Cu(II), Zn(II) and Hg(II) Complexes of a New Azo-Azomethine as Ligand: Synthesis, Potentiometric, Spectral and Thermal Studies Spectrochim Acta A Mol Biomol Spectrosc2011;78(5):1429-36. DOI: 10.1016/j.saa.2011.01.022

[10] M.B. Halli, R.B. Sumathi, Mallikarjun Kinni Synthesis, spectroscopic characterization and biological evaluation studies of Schiff's base derived from naphthofuran-2-carbohydrazide with 8-formyl-7-hydroxy-4-methyl coumarin and its metal complexes, Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 99 (2012) 46–56

[11] Raziyeh Arab Ahmadi and Saeid Amani ,Synthesis, Spectroscopy, Thermal Analysis, Magnetic Properties and Biological Activity Studies of Cu(II) and Co(II) Complexes with Schiff Base Dye Ligands, Molecules 2012,17,6434-6448; doi:10.3390/molecules17066434 [12] Hamid Khanmohammadi , Khatereh Rezaeian Thermally stable water insoluble azo-azomethine dyes: Synthesis, characterization and solvatochromic properties, Spectrochimica Acta Part A: Molecular and Biomolecular Spectroscopy 97, 2012, 652-658

[13] Hoda A. Bayoumi, Abdel-Nasser M.A. Alaghaz and Mutlak Sh. Aljahdali Cu(II), Ni(II), Co(II) and Cr(III) Complexes with N2O2-Chelating Schiff's Base Ligand Incorporating Azo and Sulfonamide Moieties: Spectroscopic, Electrochemical Behavior and Thermal Decomposition Studies Int. J. Electrochem. Sci., 8 (2013) 9399 – 9413

[14] C. Anitha, C. D. Sheela, P. Tharmaraj, and V. V. Hema Synthesis, Spectroscopic Characterization, and Biological Activities of Metal Complexes of4-((4-Chlorophenyl)diazenyl)-2-((***p***-tolylimino)

methyl) phenol Journal of Chemistry 2013,1-12 http://dx.doi.org/10.1155/2013/724163

[15] Al-hamdani A. S. , Balkhi, A. M. and Falah, A. Synthesis, Spectroscopic and biological activity Studies of Azo-Schiff base and Metal Complexes derived from 5-Methyltryptamine Damascus University Journal for Basic Sciences 29, (2), 2013 .21

[16]Alaghaz, A.M.A , Zayed, M.E., Alharbi, S.A. ,Synthesis, spectral characterization, molecular modeling and antimicrobial studies of tridentate azo-dye Schiff base metal complexes, Journal of Molecular Structure (2014), doi: http://dx.doi.org/10.1016/j.molstruc.2014.12.013

[17]Bal,M.,Ceyhan,G¨. Avar, B. Kose, M. Kayraldiz , A., Kurtoglu ,M¨.,,Synthesis and X-ray powder diffraction, electrochemical, and genotoxic properties of a new azo-Schiff base and its metal complexes Turkish Journal of Chemistry Turk J Chem (2014) 38: 222 – 241

[18]Bal,S.,Connolly, J.D. Synthesis, characterization, thermal and catalytic properties of a novel carbazole derived Azo ligand and its metal complexes. Arabian Journal of Chemistry (2015), http://dx.doi.org/10.1016/j.arabjc.2015.11.012

[19] İkiz, M. , İspir, E.,Aytar, E. Ulusoy, M. Karabuğa, Ş., Aslantaş, M ,and Çelik, Ö Chemical fixation of CO_2 into cyclic carbonates by azo-containing Schiff base metal complexes *New J. Chem.*, 2015,39, 7786-7796

[20] Suchithra, R, Sounthari, P, Kiruthika, A, Chitra, S, Parameswari, K and Vijitha J: Ru(III) Azo Schiff Base Complexes: Synthesis, Spectral Characterization, Antimicrobial And Anticancer Studies. Int J Pharm Sci Res 2015; 6(3): 1283-93.doi: 10.13040/IJPSR.0975-8232.6 (3).1283-93.

[21] Raheem T. Mahdi , Abid Allah M. Ali and Huda A. Noaman, Preparation and Characterization of Some Metal Complexes with New Heterocyclic Schiff-Azo Ligand Journal of Al-Nahrain University Science 71 (4), 2014, pp.17-18

[22] M. A. Zayed, Arafa Belal, and S. M. A. H. Ragha, Structure Studies of the Prepared Novel Hydrazone Schiff's Base Complexes Using Spectroscopic, Thermal Analyses and Their Biological Activities, Journal of Transition Metal Complexes,1,(2018),art236047. doi:10.4303/jtmc/236047

[23] Kai Zhang, Chao Zhang and Kongliang Xie Synthesis of novel Schiff base metal complexes with reactive groups and their catalytic property for hydrogen peroxide decomposition The 2015 DOI: 10.1177/0040517515573411

[24] Selma BalJoseph Donald Connolly Synthesis, characterization, thermal and catalyticproperties of a novel carbazole derived Azo ligandand its metal complexes Arabian Journal of Chemistry 10, 6, September 2017, Pages 761-768

[25] Zuhria Salem Synthesis and Study of an Azo-azomethine Dyes with N,O Donor Set of Atoms and Their Cu (II), Co (II) and Ni(II) Complexes Chemistry and Materials Research.9 3, 2017 10

[26] Hussien A. K, Yousif E. I, Hasan H. A. Ahmed R. M. Metal Complexes Derived from Mixed Azo-Linked Schiff-Base Ligandwith Dithiocarbamate Derivative: Formation, Spectral Characterization and Biological Study. Orient J Chem 2018;34(3). Sahoo J, Paidesetty SK. Antimicrobial activity of novel synthesized coumarin based transitional metal complexes. J Taibah Univ Med Sc 2017;12(2):115-124

[27] Al Zoubi ,W, Al-Hamdani, AAS, Ahmed ,SD, Ko YG. A new azo-Schiff base: Synthesis, characterization, biological activity and theoretical studies of its complexes. Appl Organometal Chem. 2018;32:e3895. https://doi.org/10.1002/ aoc.3895

[28] Ahmed K. Hussien, Enaam I. Yousif, Hasan A. Hasan and Riyadh M. Ah Metal Complexes Derived from Mixed Azo-linked Schiff-base Ligand with Dithiocarbamate Derivative: Formation, Spectral Characterization and Biological Study Orient. J. Chem., Vol. 34(3), 1492-1503 (2018)

[29] Azam, M. , Al-Resayes, S I., Mohammad S., Mohammad ,W, Bhaskar, A, Mahboob ,C, Satyendra Nath, A, Pratiksha S, Nader G., Albaqami, T. M., Shahidul M.,Islam, and Park,S., Synthesis, Structural Characterization and Antimicrobial Activity of Cu(II) and Fe(III) Complexes Incorporating Azo-Azomethine LigandMolecules. 2018; 23(4): 813 doi: 10.3390/molecules23040813

[30] Mahdi, E.S., Al-Sa'edi, R. T M., Preparation and Antibacterial Activity of New Azo-Schiff Thiazol Ligand and Some of its Metal Complexes. Nano Biomed. Eng., 2018, 10(4): 369-378. DOI: 10.5101/nbe.v10i4.p369-378

[31] Al-Adilee, K. J., Dakheel ,H. K.**,** Synthesis, Spectral and Biological Studies of Ni(II), Pd(II), and Pt(IV) Complexes with New Heterocyclic ligand Derived from Azo- Schiff Bases Dye Eurasian Journal of Analytical Chemistry, 2018, 13(5), 64 https://doi.org/10.29333/ejac/97267

[32] Erdem E., Sari , E. Y. kılınçarslan , R., Kabay ,N. ,Synthesis and characterization of azo-linked Schiff bases and their nickel(II), copper(II), and zinc(II) complexes, Transition Metal Chemistry 34(2):167-174, 2009, DOI: 10.1007/s11243-008-9173-9

[33] Al-Atbi , H.S, Al-Salami, B.K, and Al-Assadind, I. J ,New azo-azomethine derivative of sulfanilamide:Synthesis, Characterization, Spectroscopic , Antimicrobial and Antioxidant activity study International Science Conference IOP Conf. Series: Journal of Physics: Conf. Series 1294 (2019) 052033 doi:10.1088/1742-6596/1294/5/052033

[34] Yahya,W.I., Mahdi R.T. and AlHakeim H.K.,Synthesis, Spectral Identification and Biological Activity of Chelate Complexes Derived from New Azo Naphthresorcenol. Series: Journal of Physics: Conf. Series 1294 (2019) 052066 10.1088/1742-6596/1294/5/052066

[35] Mangesh, S. , Dhavan, K., Jadhav, P. P., Suresh, B, L. ,Pawar, D.,Synthesis of Azo Schiff Base Ligands and Their Ni(II), Cu(II) and Zn(II) Metal Complexes as Highly-Active Antibacterial Agents *Chemistry Select* 2019, *DOI: 10.1002/slct.201901605*

[36]Taha, N. , Tapabashi, N. and El-Subeyhi, M. (2018) Green Synthesis of New Tetra Schiff Bases and Bis-Azo Bis-Schiff Bases Derived from 2,6-Diaminopyridine as Promising Photosensitizers. *International Journal of Organic Chemistry*, **8**, 309-318. doi: 10.4236/ijoc.2018.83023.

[37] Ali, L., M, Nadia Izet Mahdi, Radhiyah Abdul Baqi Aldujaili Preparation, Characterization and The Biological Activity Study of A New heterocyclic (Azo-Schiff base) Ligand and Their Complexation with {Co,Ni,Cu,Zn(II)}Ions, Egypt.J.Chem. Vol. 63, No.1. pp. 289- 300 (2020)

[38] Ekhlas, Q. ,Jasim, E. A., Alasadi , Fayadh , R.H. , Muhamman-Ali, M. A., Synthesis and Antibacterial Evaluation of Some AzoSchiff Base Ligands and Estimation the Cadmium Metal by Complexation, Sys Rev Pharm 2020;11(6): 677

[39] Shili, A., Ayadi ,A, Taboukhat, S., Zouari N. Sahraoui, B. El-Ghayoury A, Azo-based phenylthiophene Schiff bases: Syntheses, crystal structures and optical properties , *Journal of Molecular Structure , DOI: 10.1016/ j.molstruc. 2020.12893387*

[40] Hadi, M. A., & Kareem, I. K. (2020). Synthesis, Characterization and Spectral Studies of a New Azo-Schiff base Ligand Derived from 3,4-diamino benzophenone and its Complexes with Selected Metal Ions. *Research Journal in Advanced Sciences*, *1*(1). 2020