

SYNTHESIS, PHYSICO-CHEMICAL AND ANTIMICROBIAL PROPERTIES OF SOME METAL (II) -MIXED LIGAND COMPLEXES OF TRIDENTATE SCHIFF BASE DERIVES FROM B-LACTAM ANTIBIOTIC {(CEPHALEXIN MONO HYDRATE)-4- CHLOROBENZALDEHYDE} AND SACCHARIN

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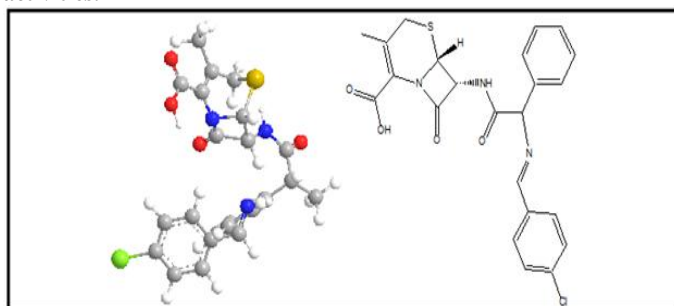
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Abstract— A new Schiff base 4-chlorophenyl)methanimine (6R,7R)-3-methyl-8-oxo-7-(2-phenylpropanamido)-5-thia-1-azabicyclo[4.2.0]oct-2-ene-2-carboxylate= (HL)= C₂₃H₂₀CIN₃O₄S) has been synthesized from β-lactam antibiotic (cephalexin mono hydrate)(CephH)=(C₁₆H₁₉N₃O₅·H₂O) and 4-chlorobenzaldehyde . Figure(1) Metal mixed ligand complexes of the Schiff base were prepared from chloride salt of Fe(II),Co(II),Ni(II),Cu(II),Zn(II) and Cd (II), in 50% (v/v) ethanol –water medium (SacH) .in aqueous ethanol(1:1) containing and Saccharin(C₇H₅NO₃S) = sodium hydroxide. Several physical tools in particular; IR, CHN, ¹H NMR, ¹³C NMR for ligand and melting point molar conductance, magnetic moment. and determination the percentage of the metal in the complexes by flame(AAS). The ligands and there metal complexes were screened for their antimicrobial activity against four bacteria (gram + ve) and (gram -ve) {Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus and Bacillus}. The proposed structure of the complexes using program, Chem office 3D(2006). The general formula have been given for the prepared mixed ligand complexes Na₂[M(Sac)₃(L)], M(II) = Fe (II), Co(II) , Ni(II), Cu (II), Zn(II) , and Cd(II).

HL= C₂₉H₂₄ C₁N₃O₄S, L= C₂₉H₂₃ C₁N₃O₄S -.

Key words— (Cephalexin antibiotics, Saccharin, Schiff base, Spectral studies drugs mixed ligand complexes, and antibacterial activities.



Figure(1):structural of the HL (3D)

I. INTRODUCTION

Metal complexes of the Schiff bases are generally prepared by treating metal salts with Schiff base ligands under suitable experimental conditions. However, for some catalytic application the Schiff base metal complexes are prepared in situ in the reaction system. [1].Generally the organic compounds

containing hetero atoms like O,N ,S and P are found to work as very effective corrosion inhibitors [2-3]

Schiff bases have been studied extensively because of their high potential chemical permutation. Magnetic susceptibility, absorption spectra, elemental analysis, molecular weight determination, conductivity, thermal analysis of many Schiff bases and their complexes have been reported.[4-5]Several workers also studied their biological properties, such as antibacterial, antifungal, activities.[6-7]

Saccharin (C₇H₅NO₃S), also called o-sulfobenzamide, is widely used as an artificial sweetening agent. Saccharin is a weak acid [8].

The structures of Co(II) [7], Ni(II) [8], Cu(II) [9] and Cd(II) [10] imidazole saccharinates were reported.

In this paper we present the synthesis and study of Fe(II),Co(II),Ni(II), Cu(II),

Zn(II),and Cd(II) complexes with tridentate Schiff base derives from β-lactam antibiotic { (cephalexin mono hydrate)-4-chlorobenzaldehyde } as a primary ligand and Saccharin as secondary ligand. Their structures were confirmed by Uv-Vis . IR and NMR spectral analysis. Further, their antibacterial activity towards some clinically important bacteria was evaluated.

II. EXPERIMENTAL

A. Chemicals

All chemical reagents and solvents used were of analytical grade and were used without further purification and were used as received, CuCl₂·H₂O, CdCl₂·H₂O, ZnCl₂, FeCl₂·9H₂O.MnCl₂·2H₂O, CoCl₂·6H₂O,NiCl₂·6H₂O, NaOH (supplied by either Merck or Fluka) ethanol, methanol dimethylformamide, and KBr, acetone , benzene, 4-chlorobenzaldehyde, and chloroform from (B.D.H).Cephalexin powder DSM (Spain).

B. Instrumentals

Elemental micro analysis for the ligands was performed on a (C.H.N.) Euro EA 3000. In Ibn Al-Haitham College of Education, University of Baghdad, Iraq.

¹H NMR spectra were recorded using Bruker DRX system 500 (500 MHz) and ¹³C-¹H hetero nuclear 2D correlation

spectroscopy (COSY), HETCOR), in the Department of Chemistry Sharif University, Tehran, Iran.

UV-Vis spectra were recorded on a (Shimadzu UV- 160A) Ultra Violet-Visible Spectrophotometer. IR- spectra were taken on a (Shimadzu, FTI R- 8400S) Fourier Transform Infrared Spectrophotometer (4000- 400) cm⁻¹ with samples prepared as KBr discs. Metal contents of the complexes were determined by atomic absorption (A.A) technique using a Shimadzu AA 620G atomic absorption spectrophotometer. The Chloride contents of complexes were determined by potentiometric titration method using (686-Titro processor-665. Dosimat Metrohn Swiss). Conductivities were measured for 10-3M of complexes in DMSO at 25oC using (conductivity meter, Jewnary, model 4070). Magnetic measurements were recorded on a Bruker BM6 instrument at 298 K following the Farady's method. In addition melting points were obtained using (Stuart Melting Point Apparatus). The proposed molecular structure of the complexes were drawing by using chem. office prog 3DX (2006).

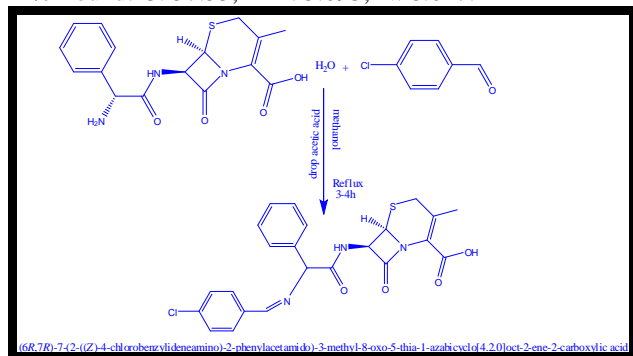
C. SYNTHESIS OF SCHIFF BASE (HL)

The Schiff base ligand was prepared by condensation of (2.92 gm,8mmol) of Cephalexin mono hydrate in (15ml) methanol and of (1.12 g m , 8mmol) of 4-chlorobenzaldehyde in (15ml) methanol was refluxed on water bath for 3-4 hours in presence of few drops of glacial acetic acid. The yellow coloured solid mass formed during refluxing was cooled to room temperature, filtered and washed thoroughly with methanol, washed with hot acetone and recrystallized from acetone to get a pure sample. Yield: 83%, m p: 205-210o C.

M.W= 469. 94, (C₂₃H₂₀N₃ ClO₄ S). see scheme (2-1) .

% Calculated: 58. 78 , H: 4.92, N: 8;94

% Found: C: 57.55, H: 5.093, N: 8.627.



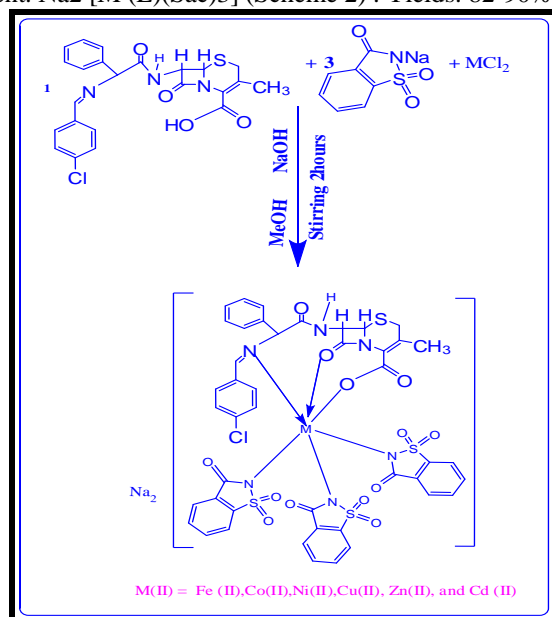
Scheme (1): The synthesis route of ligand (HL)

D. General preparing of the mixed ligands metal complexes

The complexes were prepared by a similar method of synthesis using the reagents in molar ratio of 1:3:1. Of M: L: 3Sac.

A methanolic solution (15 mL, 1m mol) of the appropriate FeCl₂.6H₂O. (0.180gm, 1mmol), CoCl₂.6H₂O (0.237gm, 1mmol), NiCl₂.6H₂O (0.238gm, 1mmol), CuCl₂.2H₂O (0.176gm, 1mmol), ZnCl₂(0.136gm, 1mmol),CdCl₂ (0.183gm, 1mmol); was added to a methanolic solution (15ml) of the Schiff base, primary ligand [HL] (1m mol) and methanolic solution (0. 549g, 3mmol) of the secondary ligand sodium saccharinate was added to the previous solution and the reaction mixture was refluxed for about 2-3 h on a water bath and then aqueous alcoholic solution of Na OH (V: V) was added to the mixture to adjust the pH 6 to 8 and further refluxed for about an hour with constant stirring . The

complexes precipitated were filtered and washed with distilled water, then with methanol and recrystallized using acetone solvent. Na₂ [M (L)(Sac)₃] (Scheme 2) . Yields: 82-90%.



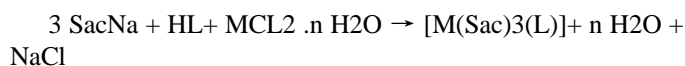
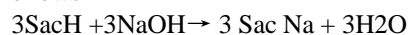
Scheme (2): The synthesis route of Metal(II) -(Schiff base HL -Sac) Mixed Ligand Complexes

III. RESULTS AND DISCUSSION

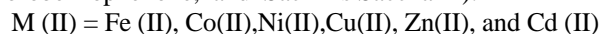
The data obtained from analytical and physico-chemical studies have been correlated in a logical way to explain the properties, bonding and structures of the compounds.

A. Characterization of the ligand,

Generally, the complexes were prepared by reacting the respective metal salts with the ligands using 1:1:3 mole ratios.[M: L3 :3(Sac)], i.e. one mole of metal salt : one mole of Schiff base(HL) and three moles of sodium Saccharinate The synthesis of mixed ligand metal complexes may be represented as follows



(where HL is Schiff base derives from selected β-lactam antibiotic (cephalexin monohydrate) with 4-chlorobenzophenone, and Sac H is Saccharin).



B. Physical properties

The formula weights and melting points, are given in table (1).Based on the physicochemical characteristics, it was found that all the complexes were non- hygroscopic, All complexes are insoluble in most organic solvent, but soluble in ethanol, DMF and DMSO. The complexes were dissolved in DMSO and the molar conductivity values of 10-3 M solution at 25 o C of the complexes are in the range 63.55-77.36 ohm-1mol-1 cm². It is obvious from these data that complexes are electrolytes types 1: 2 [11]. The test for halide ion with AgNO₃ solution was negative indicating that halide ion is inside the coordination sphere of the central metal [12]. The ligand, HL was yellow in color with a melting point of 162oC. The analytical data showed closed agreement with the suggested formula of C₂₃H₂₀ ClN₃O₄S. It was further characterized by ¹H NMR,¹³C NMR and FT-IR

C. spectral data

The (FT-IR) spectrum for the starting material saccharin (Sac H) Table(3). In saccharin the bands for stretching vibration of N-H and (CNS) are found at 3402 and 966 cm⁻¹ respectively. The absorption band for stretching vibration of (C = O) appeared at 1705 cm⁻¹. The absorption bands in the region 1333 to 1553 cm⁻¹ is for C = C in the aromatic ring, 1292 cm⁻¹ for C-N single bond, and at 1692 cm⁻¹ for C-O single bond. The two SO₂ stretching vibrations appear at similar frequencies(1292 and 1178 cm⁻¹ for ν asym(SO₂) asym and ν sym (SO₂) sym, respectively. [13-14] The (FT-IR) spectrum for the ligand (HL), displays bands at (3211, 3045) cm⁻¹ due to ν (N-H) secondary amine stretching vibration, and disappeared the band for the ν (N-H) primary amine stretching vibration.

The spectrum displays a new band at (1689) cm⁻¹ is due ν (HC=N-) group of the azomethine stretching vibrations of the ligand [125]. Where The band at (1759) cm⁻¹ is due to Stretch grouping ν (C=O) for (COOH) and strong ν (OH) stretching at 3423cm⁻¹ corresponding to carboxylic group.

The band at (1689) cm⁻¹ stretching vibration is due to ν (C=O) for β -Lactam group overlapping with ν (-HC=N-); The bands at (1593) and (1398) cm⁻¹ were assigned to stretching vibration (COOH) asymmetric and symmetric stretching vibration, respectively. $\Delta\nu = [\nu$ asym (COO-) - ν sym (COO-)] is (195 cm⁻¹). These values are quite agreeable with the values reported earlier [124-125].

The bands at (1502), (3045), (1163), and (2813) were assigned to ν (C=C) aromatic, ν (C-H) aromatic, (ν (C-C) aliphatic., and ν (C-C) aromatic) stretching vibration respectively. The band at (1315) cm⁻¹ is due to ν (C-N) cm⁻¹ stretching vibration. The band at (1282) cm⁻¹ was assigned to ν (C-O) stretching vibration [123]. The band at (582) cm⁻¹ was assigned to ν (C-S) stretching vibration [13-14].

The assignment of the characteristic bands (FT-IR) spectra for the free ligand (HL), are summarized in Table (2) and (3) respectively.

FT-IR of Na₂[Fe(L)(Sac)3] (1), Na₂[Co(L)(Sac)3] (2), Na₂[Ni(L)(Sac)3] (3), Na₂[Cu(L)(Sac)3] (4), Na₂[Zn(L)(Sac)3] (5) and Na₂[Cd(L)(Sac)3] (6) complexes:

The FT-IR spectra for complexes (1), (2), (3), (4), (5), and (6), are summarized in table (4). The spectrum of the (HL) displays a new band at (1689) cm⁻¹ is due to ν (HC=N-) group of the azomethine stretching vibrations of the ligand [125,128]. on complexation these band has been shifted to lower frequencies (1620), (1629), (1629), (1585), (1629) and (1585) cm⁻¹ for complexes (1), (2), (3), (4), (5) and (6). This bands gets shifted to lower frequency in the complexes, indicating the coordination through azomethine nitrogen to metal atom. [5, 14, 15].

The bands at (1593), and (1398) cm⁻¹ were assigned to stretching vibration (COOH) asymmetric and symmetric stretching vibration, respectively. on complexation these bands have been shifted to lower frequencies [(1581), (1587), (1527), (1527), (1587) and (1558) cm⁻¹ for Δ (-COO)asy], and [(1336), (1334), (1394), (1380), (1334), and (1358) cm⁻¹ for Δ (-COO) sy] for the compounds (1), (2), (3), (4), (5) and (6), that the coordination with metal was occurred through the oxygen atom of carboxylate ion. Moreover, Δ (ν (COO-) - ν (COO-)) values of complexes below 200 cm⁻¹ would be expected for bridging or chelating carboxylates but greater than 200 cm⁻¹ for the monodentate bonding carboxylate anions [6,13]. The un altered position of a band due to ring ν (C-S) in

all the metal complexes indicates that, these groups are not involved in coordination. Some new bands of weak intensity observed in the regions around (526-474)cm⁻¹ and (418-486) cm⁻¹ may be ascribed to M-N and M-O vibrations, respectively [14-15]. It may be noted that, these vibrational bands are absent in the spectra of the ligands.[15-16]

(U.V-Vis) Spectral data for the Schiff bases mixed ligands complexes [Fe(L)(Sac)3], [Co(L)(Sac)3], [Ni(L)(Sac)3], [Cu(L)(Sac)3], [Zn(L)(Sac)3] and [Cd(L)(Sac)3].

The UV-Vis spectrum of the ligand (saccharin) shows peaks at 275 nm (36363 cm⁻¹)(ϵ _{max}=142 molar⁻¹.cm⁻¹), 340 nm (21422 cm⁻¹)(ϵ _{max}=168 molar⁻¹.cm⁻¹) assigned to (π - π^*) and (n - π^*) electronic transitions. [17]

The UV-Vis spectrum of the ligand (HL) shows peaks at 300 nm (33333 cm⁻¹) (ϵ _{max}=880 molar⁻¹.cm⁻¹), assigned to (n - π^*) electronic transitions within the organic ligand, [17- 18] The absorption data for complexes are given in Table (5).

Na₂[Fe(L)(Sac)3]

The magnetic moment table (3-27) of the Fe (II) d₆ complex is 4.72 B.M.

The (U.V- Vis) Fe (II) spectrum, exhibits four peaks. The assignment of the electronic spectral bands, their positions, and the spectral parameters for Fe (II) which is in agreement with data reported by several research workers [24,7], the first high intense peak at (273 nm)(36630 cm⁻¹)(ϵ _{max} =1189 molar⁻¹.cm⁻¹) is due to the (L.F), while the second peak at (299nm)(334442 cm⁻¹)(ϵ _{max} =1208 molar⁻¹.cm⁻¹) and third peak at (345 nm)(28985 cm⁻¹)(ϵ _{max} =1208 molar⁻¹.cm⁻¹) are due to the (C-T). The fourth peak at (757 nm)(13210 cm⁻¹) (ϵ _{max} =42 molar⁻¹.cm⁻¹) is due to the 5T_{2g}→5E_g transition. [5,18]. These results reveal the distorted octahedral geometry for these complex.[17]

Na₂[Co(L)(Sac)3]

The electronic absorption spectrum of Co (II) d₇ complex showed five absorption bands as shown in table (5). The assignment of the electronic spectral bands, their positions, and the spectral parameters for Co (II) which is in agreement with data reported by several research workers [124,127], the first high intense peak at (273 nm)(36630 cm⁻¹)(ϵ _{max} =1340 molar⁻¹.cm⁻¹) is due to the (L.F), while the second peak at (299 nm)(334442 cm⁻¹) (ϵ _{max} =1379 molar⁻¹.cm⁻¹) and third peak at (345 nm)(28985 cm⁻¹)(ϵ _{max} =1383 molar⁻¹.cm⁻¹) are due to the (C-T). The fourth peak at(862nm)(11600 cm⁻¹)(ϵ _{max} =28 molar⁻¹.cm⁻¹) and fifth peak at (981 nm)(10193 cm⁻¹)(ϵ _{max} =145 molar⁻¹.cm⁻¹) are due to the 4T_{1g}→4T_{1g} (P) (ν 3) and 4T_{1g} → 4A_{2g} (ν 2) respectively. The magnetic moment table (3-26) of the Co (II) complex is 3.51B.M suggesting octahedral geometry for the Co (II) complexes. [5,17]

Na₂[Ni(L)(Sac)3]

The electronic absorption spectrum of Ni (II) d₈ complex showed five absorption bands as shown in table (5). The assignment of the electronic spectral bands, their positions, and the spectral parameters for Ni (II) which is in agreement with data reported by several research workers[124,127], the first high intense peak at (272 nm)(36764 cm⁻¹)(ϵ _{max} =1188 molar⁻¹.cm⁻¹) is due to the (L.F), while the second peak at (344 nm)(29069 cm⁻¹)(ϵ _{max} =2073 molar⁻¹.cm⁻¹) and third peak at (358 nm)(27932 cm⁻¹) (ϵ _{max} =1383 molar⁻¹.cm⁻¹) are due to the (C-T). The fourth peak at(885 nm)(11299 cm⁻¹)(ϵ _{max} =12 molar⁻¹.cm⁻¹) and fifth peak at (980 nm)(10204 cm⁻¹)(ϵ _{max} =104 molar⁻¹.cm⁻¹) are due to the 3A_{2g}

(F) $\rightarrow 3T_{1g}$ (P) (ν_3) and $3A_{2g}(F) \rightarrow 3T_{1g}(F)$ (ν_2) respectively. The magnetic moment table (3-2276) of the Ni (II) complex is 2.77 B.M suggesting octahedral geometry for the Ni (II) complexes.[17 , 19].

Na₂[Cu (L)(Sac)3]

The electronic absorption of Cu(II) d8 complex showed three absorption bands as shown in table (5). The first high intense peak at (271 nm)(36900 cm⁻¹)(ϵ_{max} =1039 molar⁻¹.cm⁻¹) is due to the (L.F) , while the second peak at (348 nm) (28735 cm⁻¹)(ϵ_{max} =485 molar⁻¹.cm⁻¹) and third peak is observed multiple absorption band at 11682 cm⁻¹ – 16500 cm⁻¹ but they are overlapped. Because, octahedral complexes of Cu(II) are observable distorted by Jahn-Teller effect and the structure of complex is to name pseudo-octahedral. It was taken notice of top of the peak as absorption band and d - d transition at about 11682 cm⁻¹ (2E_g \rightarrow 2T_{2g}) for Cu(II) complex. The complex has a room temperature magnetic moment of 1.71 B.M. which corresponds to distorted octahedral structure for the Cu (II) ion,[19-.20].

Na₂[Zn (L)(Sac)3] and Na₂[Cd (L)(Sac)3]

The electronic spectra of d10[Zn(II) and Cd(II)]complexes do show the charge transfer. The magnetic susceptibility shows that two complexes have diamagnetic moments., because d-d transitions are not possible hence electronic spectra did not give any fruitful information. in fact this result is a good agreement with previous work of octahedral geometry [16,19,21].

D. Magnetic susceptibility

The observed magnetic moment values of the prepared complexes are summarized in table (6).Examination of these data reveals that magnet moment of 0.0 B.M for Cd (II) and Zn complexes confirms that the complexes are essentially diamagnetic. The magnetic moment found for Fe(II),Co (II), Ni (II), Cu (II), 4.72, 3.51, 2.77, 1.71 B.M respectively these values suggest octahedral geometry which is in good agreement with data of electronic transition. The electronic spectra and the magnetic moments support the stereochemistry of the complexes [12-120]

E. NMR Spectral studies

The integral intensities of each signal in the ¹H NMR spectrum of ligand was found to agree with the number of different types of protons present. In the ¹H NMR spectrum of the ligand, the formation of Schiff base is supported by the presence of a singlet at (δ 8.21) ppm corresponding to the azomethine proton ($-\text{N}=\text{CH}-$).The signal obtained in range (δ 7.77-7.92) ppm was assigned for doublet due one proton of aromatic ring of phenyl. Three groups of double peaks given by (CO-CH) and (N-CH) on the beta-Lactam ring and (NH sec.) amide appeared at (δ 4.48), (δ 5.06) and (δ 8.08) ppm, respectively. This confirms the formations of imine ligand. This observation was also supported by the FTIR data of the ligand discussed earlier. One group of four resonance signals attributed to (S-CH) on the dihydrothiazine ring was observed in the (δ 2.92-3.27) ppm. and 9.53 ppm (1H, s, $-\text{NH}-\text{CO}$); This observation was also supported by the FTIR data of the ligand discussed earlier. [23, 24].The NMR spectral data of HL was compared with the spectral data for the similar ligands reported in literatures [23, 24].

The ¹³C NMR spectrum of the ligand [HL] in DMSO-d₆ solvent shown

(C6; C7; C8; β -lactam);135 .65; 131. 63; 130.18).The four resonance at (δ =140.87, δ = 140.42, δ = 140.12, δ = 139.92 ppm) assigned to carbon atoms of aromatic ring (C1, C2, C4, C3) respectively. ($-\text{HC}=\text{N}$); 146.14.

F. The proposed molecular structure for Na₂[M (L)(Sac)3]

Studying complexes on bases of the above analysis, the existence of Hexa coordinated [M (L) (Sac) 3] were, M= Fe(II),Co(II),Ni(II),Cu(II),Zn(II),and Cd(II),proposed models of the species were built with chem.3D shows in figure(2)

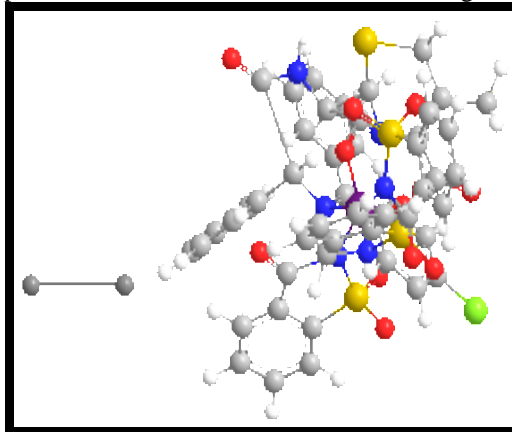


Figure (2): 3D molecular modeling proposed complexes

Na₂[M(L)(Sac)3]

M= Fe(II),Co(II),Ni(II),Cu(II),Zn(II) and Cd(II)

Antibacterial Activities studies: [25-26]

The effectiveness of an antimicrobial agent in sensitivity is based on the zones of inhibition. The synthesized metal complexes were screened for their antimicrobial activity by well plate method in nutrient agar. The invitro antibacterial activity was carried against 4 hold cultures of pathogenic bacteria like gram (+) and gram (-) at 37o C. In order to ensure that solvent had no effect on bacteria, a control test was performed with DMSO and found inactive in culture medium. Antimicrobial activity was evaluated by measuring the diameter of the inhibition zone (IZ) around the hole. Most of the tested compounds showed remarkable biological activity against different types of gram positive and gram negative bacteria. The diameter of the susceptibility zones were measured in mm and the results are presented in Table (7) [26-27]Compounds were considered as active when the (IZ) was greater than 6 mm. The zone of inhibition of the complexes against the growth of bacteria were given In table (6), figure(3) *The antibacterial activity results revealed that the ligand (HL) and its complexes shown weak to good activity.

Complexes Na₂[M (L)(Sac)3], M =Co(II) ,Ni(II) ,Cu(II) and Zn(II) show negative against all bacteria.

*The complex Na₂[Fe (L)(Sac)3] show very good antibacterial activity agains towards 3- organisms except pseudomas.

*The complex Na₂[Cd(L)(Sac)3] show good antibacterial activity against towards 4- organisms. The inhibition antibacterial property of complexes can be explained as follows. The positive charge of the metal ion is shared antibacterial between the donor atoms of the ligand. There is the possibility of delocalization of the π electron density of aromatic ring also. These two factors positively contribute to increase the lipophilic character. Upon complexation , polarity of metal ion get reduced due to the overlap of ligand orbital and

the sharing of positive charge of the metal ions with donor groups. [5,16]

REFERENCES

[1] Cozzi. P.G, Chemical Society Reviews, 33 (2004) 410-421.
 [2] Blanc C., Gastaud S., J. Electrochem.Soc. 150, 396, 2003.
 [3] Ebenso E. E., Okafo P. C r, U. J. Eppe, Anti Corr. Meth. and Mat, 50,414,2003.
 [4] Taghreed H. Al-Noor, Sajed. M. Lateef and Mazin H. Rhayma, J.Chemical and Pharmaceutical Research,(2012), 4(9):4141-4148
 [5] Taghreed H. Al-Noor, Ahmed. T. AL- Jeboori , Manhel Reemon , J. Chemistry and Materials Research ,(2013), Vol.3 No.3, 114-124
 [6] Taghreed H.Al-Noor,Ahmed T.AL- eboori , Manhel Reemon,(2013) J. Advances in Physics Theories and Applications Vol.18, 1-10.
 [7] Zhang,. J. Li, Y. Lin, W. Liu, S., J. Huang, Polyhedron, (1992), 11, 419.
 [8] Zhang, J. Li Y., Lin, W. Liu, J. S. Huang, J. Cryst. Spec. Res. (1992),, 22, 433
 [9] Liu, J. Huang, J. Li, W. ., Lin, J. Acta Crystall ogr. (1991), C47, 41.
 [10] Ke, J. Li, Y. Wang, Q. Wu X., J. Cryst. Res. Technol. (1997), 32, 481.
 [11] Geary, W. J. Coord. Chem. Rev. 1971, 7, 81-122.
 [12] Vogel A. (1978).Text Book of Quantitative Inorganic Analysis (Longman, London). 3Ed th 694.
 [13] Nakamoto; K. (1996).Infrared spectra of Inorganic and coordination compounds “4Ed th ; J. Wiely and Sons, Newyork.

[14] Silverstein R. M., Spectrophotometric Identification of Organic Compounds, 2009.John Wiley, New York, NY, USA.
 [15] Sharma, R.C Giri P.P, Devendra Kumar and Neelam, J. Chem. Pharm. Res.(2012), 4(4): 1969-1973.
 [16] Fayad N.K., Taghreed H. Al-Noor and Ghanim F.H, Journal of Advances in Physics Theories and Applications, (2012) , Vol. (9), 1-12.
 [17] Lever A.B.P., “Inorganic Electronic spectroscopy“,2rd Ed Elsevier, New York. (1984).
 [18] Taghreed H. Al-Noor, Manhel Reemon Aziz and Ahmed T. AL- Jeboori, Journal of Chemistry and Materials Research, 2013 Vol.3 No.3, 114-124.
 [19] Taghreed H. Al-Noor, Ahmed. T. AL- Jeboori, Manhel Reemon, Journal Advances in Physics Theories and Applications (2013) Vol.18, 1-10.
 [20] Dutta. R. L and Syamal A., Elements of Magnatochemistry , 2nd Ed., East west press, New Delhi, (1996).
 [21] Manchand W. ConardFernelius W., Journal of Chemical Education (1961). 38 (4) 192-201,
 [22] Fouziarafat M. Y. Siddiqi and Siddiqi., k. S. J. Serb. Chem. Soc.(2004), 69 (8–9) 641–6649
 [23] Chohan, ZH.Daniel L.M. Aguiak DE, Rosane A.S. San GIL, Leandro B. Borre, Monica R.C. Marques, Andre L. Gemal , J. Appl Organomet Chem, (2011) 20: 112- 118.
 [24] Reddy V., Patil N. and. Angadi S.D, E-J. Chem., (2008), 5(3), 577-583.
 [25] Seely H.W ,and Van Demark P J, Microbes in Action, Laboratory of Microbiology, 3rd Ed., W H Freeman and Co. U.S.A, 1981, 38
 [26] Awetz J., Melnick, And Delbrgs A,(2007), “Medical Microbiology” 4th ed McGraw Hil-USA.

Compounds Chemical (Formula)	M. wt Calc	Color	M p °c (de) °c	Λ_m $\Omega^{-1} \text{cm}^2 \text{mol}^{-1}$ In DMSO	M % Theory	M% experim ental
Na ₂ [Fe(L)(Sac) ₃]	1104	Brown Deep	166 dec	65.45	5.07	4.84
Na ₂ [Co(L)(Sac) ₃]	1107	Red-brown	240 dec	58.35	5.33	4.95
Na ₂ [Ni(L)(Sac) ₃]	1106	pale-Green	154 dec	70.23	5.24	5.07
Na ₂ [Cu(L)(Sac) ₃]	1112	- Green blue	125-130 dec	67.33	5.75	5.13
Na ₂ [Zn(L)(Sac) ₃]	1113	Yellow	230	69.72	5.84	5.35
Na ₂ [Cd(L)(Sac) ₃]	1160	Yellow	235-240	58.16	9.65	8.74

Table (1): The physical properties of the Schiff base mixed ligand Na₂ [M(L)(Sac)₃]complexes
 M. wt = Molecular Weight, Lm = Molar Conductivity, dec. = decomposition

Comp.	$\nu(\text{O-H})$	$\nu(\text{N-H})$ primary amine	$\nu(\text{N-H})$ Secondary amide	$\nu(\text{C=O})$ for COOH & carbonyl	$\nu(\text{C=O})$ β -lactam	$\nu_{\text{asym}} \text{COO}$	asomethin e group $\nu(-\text{C}=\text{N})$ group	$\nu_{\text{sym}} \text{COO}$	$\nu(\text{C}=\text{C})$ arom.	$\nu(\text{C}-\text{C})$ aliph.	$\nu(\text{C}-\text{N})$	$\nu(\text{C}-\text{O})$	$\nu(\text{C}-\text{S})$	$\nu(\text{C}-\text{H})$ arom.	$\nu(\text{C}-\text{H})$ aliph.
Ceph.H ₂ O	3423	3425 - 3275 br	3219 , 3059	1759	1691	159 5	-----	139 8	157 7	116 3	1280 s	12 47	58 2s	301 0m	288 3

Table(2):Data from the Infrared Spectrum for the Free Ligand Ceph (cm-1) and Schiff base HL

	$\nu(\text{N-H})_{\text{asy}}$ $\nu(\text{N-H})_{\text{sym}}$	$\nu(\text{C}-\text{H})_{\text{cv}}$	$\nu_{\text{asy}}(\text{SO}_2)$	$\nu_{\text{ym}}(\text{SO}_2)$	(SO ₂) $\nu_{\text{s/bs}}$	$\nu(\text{CNS})$	$\nu \text{C}=\text{O}$	$\nu(\text{C}-\text{O})_{\text{av}}$
Sac H	3402s 3113br-vs	2928vs-sh	1292 vs	1149 vs	0.88	966s	1680 1705	1692

Table (3): Infrared spectral data (wave number ν) cm-1 for the Saccharin (Sac H)
 Sym: symmetric, asy: asymmetric, am: amide, v.s: very strong, s: strong, m: medium, w: weak, sh: shoulder , arom. = aromatic, aliph = aliphatic

Comp.	$\nu(\text{N-H})$ primary amine $\nu(\text{O-H})$	$\nu(\text{C-H})$ arom. $\nu(\text{C-H})$ aliph. $\nu(\text{C-H})$ Sac	$\nu(\text{N-H})$ Seconda ry amide	$\nu(\text{C=O})$ β - lactam & Sac	ν (HC=N-)	ν_{as} COO	ν_{i} COO	$\Delta \nu$	$\nu(\text{C=C})$ arom.	$\nu(\text{C-N})$	$\nu(\text{C-O})$	$\nu(\text{C-S})$	$\nu(\text{M-N})$	$\nu(\text{M-O})$
HL	3298 *	3045* 2883m -	3275 3045*	1759s	1689	1593s	1398s	195	1546	1315	1230	582s	---	---
Fe (1)	3280*	3067* 2993 2605w	3280 3095	1720vs 1683	1620s	1581s	1336	245	1572	1323m	1259	592m	518 543	435 451w
Co (2)	3336 3255*	3064 2981* 2692	3076 3095	1649 vs	1629s	1587s	1334s	253	1533	1334s	1257s	582w	530 543w	459 443w
Ni (3)	3338 3327*	3074* 2638	3074 3103*	1649 vs	1629s	1587s	1394s	253	1508w	1334s	1259s	582w	530w 543w	480 443w
Cu (4)	3421	3066 3035 2661w	3066 3093	1637vs	1585s	1527	1380s	205	1489	1338s	1259s	543m	528w 543w	472 451w
Zn (5)	3350 3294	3088* 3064 2567w	3267* 3064	1645vs	1629vs	1587s	1334s	244	1508w	1334s	1257s	584w	530w 543w	472 459w
Cd (6)	3336 3292*	2349 2301	3292* 3066	1751s 1637vs	1585s	1558s	1358	200	1533	1338m	1255	592m	592	518

Table (4): Infrared spectral data (wave number $\hat{\nu}$) cm^{-1} for the ligand HL, and their complexes

Compounds	λ_{max}	$\hat{\nu}$ (cm^{-1})	ϵ_{max} $\text{L.mol}^{-1}.\text{cm}^{-1}$	Assignments	μ_{eff} (BM)
HL	270 348	37037 28735	924 321	$\pi \rightarrow \pi^*$ $n \rightarrow \pi^*$	
$\text{Na}_2[\text{Fe}(\text{L})(\text{Sac})_3]$	273 299 345 757	36630 33444 28985 13210	1189 1201 1685 42	L.f LMCT LMCT ${}^5\text{T}_{2g} \rightarrow {}^5\text{E}_{2g}$	4.72
$\text{Na}_2[\text{Co}(\text{L})(\text{Sac})_3]$	273 299 345 862 981	36630. 33444 28985 11600 10193	1340 1379 1383 28 145	L.f C-T C-T $4\text{T}_{1g} \rightarrow 4\text{T}_{1g}(\text{P})(\nu_3)$ $4\text{T}_{1g} \rightarrow 4\text{A}_{2g}(\nu_2)$	3.51
$\text{Na}_2[\text{Ni}(\text{L})(\text{Sac})_3]$	272 344 358 885 980	36764 29069 27932 11299 10204	1188 2073 1264 12 104	L-F C-T C-T ${}^3\text{A}_{2g}(\text{F}) \rightarrow {}^3\text{T}_{1g}(\text{P})(\nu_3)$ ${}^3\text{A}_{2g}(\text{F}) \rightarrow {}^3\text{T}_{1g}(\text{F})(\nu_2)$	2.77
$\text{Na}_2[\text{Cu}(\text{L})(\text{Sac})_3]$	271 348 856	36900 28735 11682	1039 485 34	L.f C-T ${}^2\text{E}_g \rightarrow {}^2\text{T}_{2g}$	1.71
$\text{Na}_2[\text{Zn}(\text{L})(\text{Sac})_3]$	271 345	36900 28985	1100 1077	C-T C-T	0.0
$\text{Na}_2[\text{Cd}(\text{L})(\text{Sac})_3]$	271 301 345 357	36900 33222 28985 28011	1106 925 1900 1233	C-T C-T C-T C-T	0.0

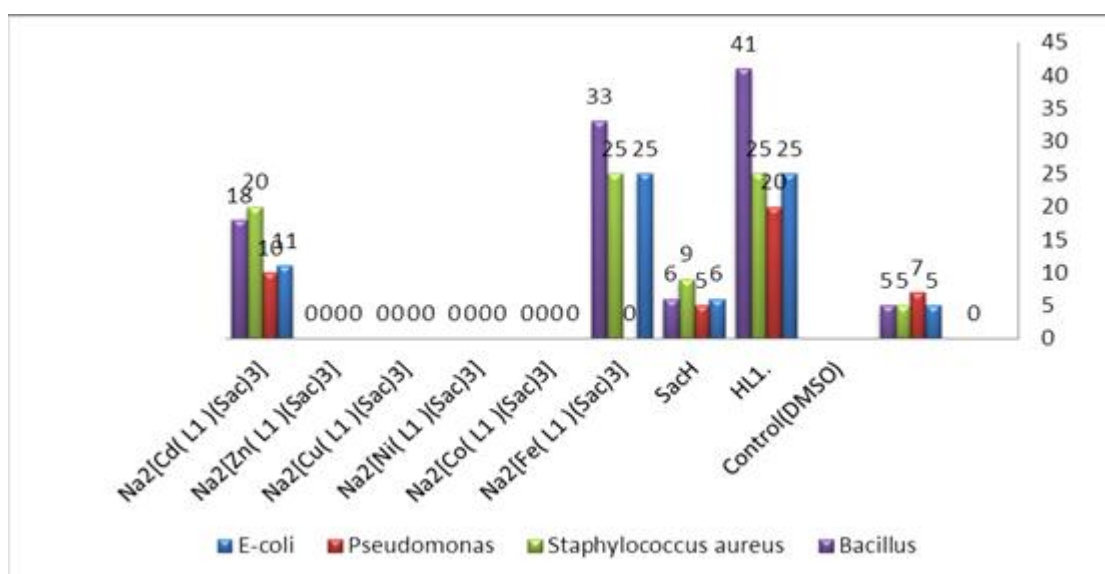
Table (5): Electronic Spectral data, magnetic moment, of the mixed ligands complexes

Complex	$X_g \cdot 10^{-6}$	$X_m \cdot 10^{-6}$	$X_A \cdot 10^{-6}$	μ_{eff} (B.M)
$\text{Na}_2[\text{Fe}(\text{L})(\text{Sac})_3]$	8.56	9451.68	9535.680	4.72
$\text{Na}_2[\text{Co}(\text{L})(\text{Sac})_3]$	4.68	5189.293	5273.293	3.51
$\text{Na}_2[\text{Ni}(\text{L})(\text{Sac})_3]$	2.90	3200.181	3284.181	2.77
$\text{Na}_2[\text{Cu}(\text{L})(\text{Sac})_3]$	1.05	1167.583	1251.583	1.71

Table (6): The magnetic measurements data of the prepared complexes

Compound	No in Petridis	<i>E-coli</i> (-ve)	<i>Pseudomonas</i> (-ve)	<i>Staphylococcus aureus</i> (+ve)	<i>Bacilluse</i>
Control(DMSO)	C	5	7	5	5
HL.	27	25	20	25	41
SacH	16	6	5	9	6
Na ₂ [Fe(L)(Sac) ₃]	31	25	0	25	33
Na ₂ [Co(L)(Sac) ₃]	32	0	0	0	0
Na ₂ [Ni(L)(Sac) ₃]	28	0	0	0	0
Na ₂ [Cu(L)(Sac) ₃]	26	0	0	0	0
Na ₂ [Zn(L)(Sac) ₃]	29	0	0	0	0
Na ₂ [Cd(L)(Sac) ₃]	30	11	10	20	18

Table (7): The antibacterial activity (Zone of inhibition) (mm) data of Schiff base (HL) and its complexes Na₂[M(L)(Sac)₃]



Figure(3) :Chart of biological effects of the Na₂[M(L)(Sac)₃]