Synthesis, Characterization, and Antibacterial Properties of mixed ligand Complexes of *(L-Leucine and 8-hydroxyquinoline) with some metals Ions*

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Abstract:

The research includes the synthesis and identification of the mixed ligands complexes of M^{+2} Ions in general composition $Na[M(Leu)_2(Q)]$ Where L-Leucine ($C_6H_{13}NO_2$)symbolized as(LeuH) as a primary ligand and 8-hydroxyqinoline,($C_9H_7NO_2$) symbolized as (8-HQ) as a secondary ligand .

The ligands and the metal chlorides were brought in to reaction at room temperature in ethanol as solvent. The reaction required the following molar ratio [(1:1:2) (metal): Q^-:2Leu^-] with M(II) ions, were M(II)=Mn(II), Fe(II),Co(II),Ni(II),Cu(II),Zn(II),Pd(II),Sn(II) and Pb(II).

INTRODUCTION :

8-hydroxyqinoline or 8-qinoline is the name most commonly used ,while its trivial name is (oxine) ,which is conventionally used for the description of chelate compounds Oxinates ,as out of seven possible hydroxyqinoles, only 8-hydroxyqinoline forms chelate with metal ions . [1]

8-hydroxyqinoline is well-characterized organic chelating ligand ,which can form covalent compounds with over 60-metal ions under controlled pH-conditions ,and its preference for transition and heavy metal cations over alkali and alkaline-earth cations is well known[2]

8-hydroxyqinoline has a wide variety of uses and its medicinal and agricultural Significances were discovered before the start of current [3-4]

The amino acid L-leucine and various transition metals are important in the biological functions of humans, animals, and plants. L- leucine is one of the twenty major amino acids and is considered an essential and aliphatic amino acid[5]

Ganesh and Co-worker[6]were prepared and characterized of mixed ligand dioxouranium(VI) and thorium(IV)complexes of 8-hydroxyquinoline as a primary ligand and amino acids such as L-proline(Pro H) and 4-hydroxy-L-proline (Hyp) as secondary ligands. These complexes have been screened for their antibacterial and cyto-toxic (IC_{50}) characteristic properties .

Several amino acids nucleophilic side chains that coordinate to transition-metal ions . there ions may be intrinsic parts of the proteins and may be required the protein's structure or function .[7-10]

Literature survey shows that no studies on the synthesis and characterization of mixed ligand complexes of L- leucine and 8-hydroxyquinoline have been reported. Hence the present paper reports the preparation, coordination and structure of new mixed ligand M(II) complexes formed with (L- leucine and 8-hydroxyquinoline).

Experimental :

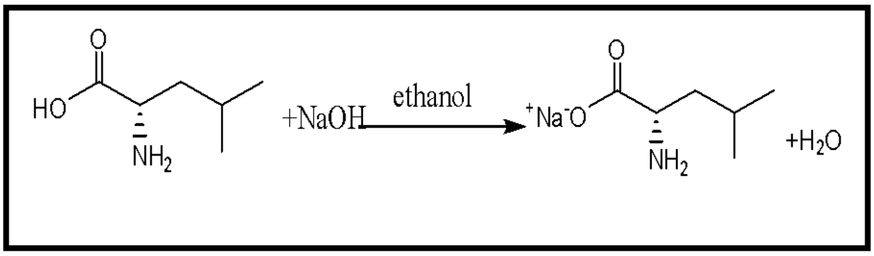
Reagents and instruments- L-Leucin was purchased from (Merck), 8-hydroxyquinoline a Fluka Chemie AG, metals chloride and solvents from (B.D.H). The reagents were used without further purification

Instruments -FT-I.R spectra were recorded as K Br discs using Fourier transform Infrared Spectrophotometer Shimadzu 24 FT-I.R 8400s. Electronic spectra of the prepared complexes were measured in the region (200- 1100) nm for 10^{-3}M solutions in ethanol at 25°C using shimadzu-U.V-160.A Ultra Violet Visible- Spectrophotometer with 1.000 ± 0.001 cm matched quartz cell. While metal contents of the complexes were determined by Atomic Absorption (A.A)Technique using Japan A.A-67G Shimadzu. chloride ion content were also evolution by (Mohr method), Electrical conductivity measurements of the complexes were recorded at 25°C for 10^{-3} M solutions of the samples in ethanol using pw 9527 Digital conductivity meter (Philips).

Magnetic susceptibility measurements were measured using Bruker magnet BM6. Melting points were recorded by using Stuart melting point apparatus. The proposed molecular structure of the complexes were determinated by using chem office program (Chem. Office– Cs. Chem– 3D progrum 2006).

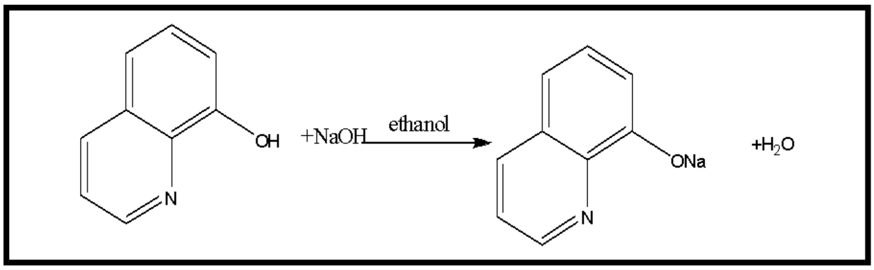
C- *General Method for the Synthesis* [11]

Sodium Leucinate(Na^+ Leu^-): L-Leucine [0.262 gm,2 m mol] was dissolved in 10 ml ethanol and added to 10 ml of ethanolic solution containing [0.08 gm (2mmol)] of the sodium hydroxide , the solution was deprotonated according to the following reaction scheme (1)



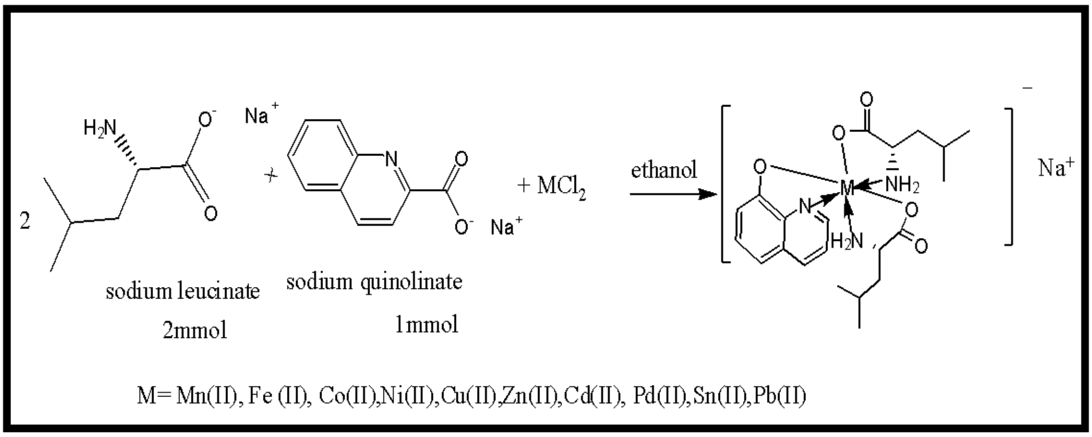
Scheme (1) : Preparation of Sodium Leucinate

Sodium-8-oxyqinolinate- [0.145gm ,1 m mol] 8-hydroxyquinoline (8-QH) with [0.04 gm (1mmol)] sodium hydroxide in ethanol was deprotonated according to the following reaction scheme(2)



Scheme (2) : Preparation of sodium-8-oxyqinolinate

Synthesis of complexes- An aqueous solution of the metal salt was added to the solution of the ligand in ethanol respectively using stoichiometric amounts [(1:1:2)(metal):Q:2Leu$^-$] molar ratio, the mixture was stirred for half an hour at room temperature, crystalline precipitates observed. The resulting precipitates were filtered off , recrystallized from ethanol and dried at room temperature. scheme (3)



Scheme (3): Preparation of the Complexes Na[M(Leu)$_2$(Q)]

Antibacterial Activities:

The antibacterial activity of the ligands and some there complex were tested on Gram positive bacteria, Staphylococcus aureus and Gram negative, Bacillus , Pseudomonas, and Candida albican. The solvent used was dimethyl formamid(DMF) and sample from 1 to 200 µg/ml were used. Ant bactericidal activities of each compound were evaluated by the well-diffusion method. 1 cm^3 of a 24 h broth culture containing 106 CFU/cm^3 was placed in sterile Petri-dishes. Molten nutrient agar(15 cm^3) kept at ca. 45°C was then poured in the Petri-dishes and allowed to solidify. Then holes of 6 mm diameter were punched carefully using a sterile cork borer and these were completely filled with the test solutions. The plates were incubated for 24 h at 37°C.

Results and Discussion :

All the complexes are colored, non-hygroscopic, indicating a strong metal-ligand bond. The complexes are insoluble in water but soluble in common organic solvents such as ethanol, ethyl alcohol, acetone, chloroform ,DMF and DMSO .The observed molar conductance (Table 1) values measured in ethanol in 10^{-3}M solution lie in the (43.78-34.89) Ω^{-1} cm^2 mol^{-1} range, indicating their electrolytic nature with(1:1). [12]

The atomic absorption measurements (Table-1) for all complexes gave approximated values for theoretical values.

Infrared spectra and mode of coordination :

The most important infrared spectral bands that provide conclusive structural evidence for the coordination of the ligands to the central metal ions .

The characteristic vibrations and assignments of ligands (QH) and (LeuH) and their complexes as K Br spectrum discs are described (Tables 2-4) , Figures(1-4)

In conclusion, our investigation this suggest that the ligands L-leucine and Sodium-8-oxyqinolinate coordinate with M (II) forming Octahedral geometry (Figur-2) Table (2), displays the (FT-IR) spectrum for the (L-Leucin) exhibited a band around υ (3417) cm^{-1} that corresponds to the stretching vibration of υ (N-H) + υ(O-H),while another strong absorption band at υ (3070) cm-1 is due to the $\upsilon(N\text{-}H_2)_{sym}$ while the bands at (1585)$cm^{-1}$and(1415)cm^{-1}were assigned to the $\upsilon(\text{-}COO^-)_{asy}$ and $\upsilon(\text{-}COO^-)_{sym}$ respectively.

$\upsilon\Delta\ (\text{-}COO^-)_{asy\text{-}sym}$ =170 cm^{-1}. [13-15]

An important feature of infra-red spectra of metal complexes with 8-HQ(Figur-2) Table (3),is the absence of the band at (3240-3047)cm^{-1}due to the O-H stretching vibration of the OH group of HQ [16]. Fig (4). This observation leads to the conclusion that the complex formation takes place by deprotonation of the hydroxyl group of HQ moiety .

A strong υ (C-O) band observed at 1104 cm^{-1} indicates the presence of 8-hydroxyquinoline moiety in the complexes coordinated through its nitrogen and oxygen atoms as uninegative bidentate ligand. [14]

The complexes show band at (590-520) cm^{-1} and (470-489) cm^{-1} rang, due to the υ (M-N) and υ (M-O) vibrations respectively. [14-16]

Magneto chemical and Electronic spectral :

The electronic spectral data of the free ligands 8-hydroxyquinoline , L-Leucin and their complexes are summarized in Table -5. together with the proposed assignments and suggested geometries. The results obtained are in good agreement with other spectra and the literature. [17]

The electronic spectra of Leucin show an absorption band at 305 nm (32786cm^{-1}) in ethanol .The UV -VIs spectrum of the free ligand (8-ydroxyquinoline) in ethanol solvent appeared a high intense absorption bands at **280** nm (**35714**cm^{-1})(ε_{max}=**1880 L. mol**$^{-}$**.cm**$^{-1}$) and at **301**nm (**33222**cm^{-1}) (ε_{max} =**2407 L. mol** $^{-}$**.cm**$^{-1}$)These bands are attributed to ($\pi\rightarrow\pi^*$)and ($n\rightarrow\pi^*$) transitions respectively. the (UV-Vis) spectrum of **Na [Co(Leu)₂(Q)]** complex bands observed at (399&351) nm are attributed to (d-d) transitions of types$^4T_1g\rightarrow{}^4T_1g_{(P)}$ &$^4T_1g\rightarrow{}^4A_2g_{(F)}$ respectively. [18-20]

Antibacterial Activities:

The zone inhibition of bacterial growth were measured in mm depending upon the diameter as shown in Table (6) Figure. (9)

The antibacterial activity results revealed that the ligands and there complexes shown weak to good activity when compared to the Control (DMF) . [21-22]

The results of antimicrobial screening, indicate that three complexes shows more activity against Staphylococcus aureus, Escherichia coli, Pseudomonas and Bacillus than Pseudomonas. The antibacterial results evidently showed that the activity of the mixed ligand complexes more pronounced when coordination to the metal ions .The activity of these substance may be due to carboxyl group[23]

Table 1-The physical properties of the Compounds

Compound	M. wt	Color	M. p °c (de) °c	Λm µS.cm^2.Mol^{-1}	Metal%		Cl%
					theory	exp	
$C_6H_{13}NO_2$ (Leu)	131.17	White	289(dec)	1.24	-	-	-
C_9H_6NO (8-HQ)	145.15	Brown-dark	277(dec)	1.77	-	-	-
Na [Mn(Leu)$_2$(Q)]	459.42	Brown-dark	290(dec)	40.55	11.55	11	Nill
Na [Fe (Leu)$_2$(Q)]	406.33	Green	>300(dec)	43.78	11.84	11	Nill
Na [Co(Leu)$_2$(Q)]	463.41	Red	>300(dec)	39.98	12.22	11	Nill
Na [Ni(Leu)$_2$(Q)]	463.17	Green	>300(dec)	40.67	19.22	21	Nill
Na [Cu(Leu)$_2$(Q)]	468.03	Green	>300(dec)	43.76	18.38	20	Nill
Na [Zn(Leu)$_2$(Q)]$^-$	469.89	light-yellow	215	43.66	12.19	10	Nill
Na [pd(Leu)$_2$(Q)]	510.90	Red	>300(dec)	34.89	12.98	14.8	Nill
Na[Sn(Leu)$_2$(Q)]	523.19	light-yellow	>300(dec	36.67	22.69	24	Nill
Na [pb (Leu)$_2$(Q)]	611.68	light-yellow	280(dec)	40.55	33.87	35	Nill

Q = C_9H_5NO , Leu $C_6H_{12}NO_2$, (Leu)$_2$(Q)= $C_{21}H_{30}N_3O_5$, **Dec. = Decomposition temperature

Table 2-FT-R spectral data of the Leucin

Compound Leucin	**υ(N-H)+ υ (O-H)**	**υ(N-H$_2$)$_{sym}$**	**Δυ**	**υ (C – H) aliphatic**	**υ(-COO)$_{asy}$**	**υ(-COO)$_{sym}$**	**υΔ (-COO)$_{asy-sym}$**
$C_6H_{13}NO_2$	3417m	3070s	347	1580s	1585vs	1415vs	170

-Hydroxyquinoline) 8 Table 3 -FT-IR spectral data of the (

Compound	υ(O-H)arom	υ(C-H)aro	υ(C=N)	υ(C=C)	υ(C-O)	δ(C-O)	δ(O-H) in plane δ(O-H)out plane
8-ydroxyquinoline	3240-3047br	3040-2854s	1577vs	1508vs	1276vs	470s	1381vs 779s

Table 4- FT-IR spectral data of the complexes Na[M (Leu)$_2$(Q)]

Complexs	**υ(N-H)+ υ (O-H)**	**(NH$_2$)sym**	**CH$_{(py)}$ str**	**(CH) cycil & ali**	**υ (C=N)**	**υ (C=C)**	**υ (C–O)**	**υ COO) asy**	**υ (-COO)$_{sym}$**	**υΔ COO) asy-sym**	**M-N**	**M-O**
Na[Mn(Leu)$_2$(Q)]	br-vs3417	-	w 2966	s2360 w2320	s1635	1573m	1273w	M1458	1373m	85	513	482
Na[Fe (Leu)$_2$(Q)]	3444m	3066m	2954s	2364m 2337m	1620s	1585vs	1234m	1415s	1336s	79	536	439m
Na[Co(Leu)$_2$(Q)]	3363br-vs	-	3062w	2985sh-vs 2360vs	1639s	1577s	1280m	1465vs	1377vs	88	513w	412m
Na[Ni(Leu)$_2$(Q)]	3356vs	3294vs	2954s	2870s 2526m	1627vs	1585vs	1238m	1465s	1381s	84	540m	439m
Na[Cu((Leu)$_2$(Q)]	3448br-s- 3244s	3147w	3051w	2954s	1608vs	1577s	1280m	1482vs	1381vs	101	516m	489m
Na[Zn(Leu)$_2$(Q)]	3448 br-vs	3255m	2954s	2870m 2360 sh	1612vs	1504vs	1292m	1465vs	1388s	77	545m	505m
Na[pd(Leu)$_2$(Q)]	3456m-	3232m	3059 m	2958s	1639s	1500vs	1288m	Vs1458	1373vs	85	532s	470m
Na[pb (Leu)$_2$(Q)]	3460vs- sh	3140w	-	2954w 2360	1624m	1566m	1280m	1444vs	1377s	133	547m	478m
Na[Sn (Leu)$_2$(Q)]	3421 br-m	3066m	2974 m	2954s	1620vs	1585vs	1234m	1515s	1361m	154	536m	435m

Sym: symmetric, say: asymmetric, am: amide, py: pyridine, str: stretching, vs.: very strong, s: strong, m: medium, w: week, sh: shoulder.

Table 5- Electronic Spectral data, magnetic moment, of the studied Compounds

Complexes	**λ_{nm}**	**$\upsilon^{-}{}_{(Cm)}{}^{-1}$**	**ξ_{max} L. mol^{-}.cm^{-1}**	**μ_{eff} (BM)**	**Assignment**
$C_6H_{13}NO_2$ (leu)	305	32786	310	-	$\pi \rightarrow \pi^*$
8-Hydroxyqinoline	280 301	35714 33222	1880 2407	-	$\pi \rightarrow \pi$ $n \rightarrow \pi^*$
Na[Mn(Leu)$_2$(Q)]	910 798 387 223	10989 12531 25839 44843	43 39 31 169	5.34	${}^{6a}{}_{1g} \rightarrow {}^4T_{2g}(G)$ ${}^6A_{1g} \rightarrow {}^4E_{1g}\,{}^4A_{1g}(G)$ ${}^6A_{1g} \rightarrow {}^4T_{1g}(D)$ Ligand field
Na[Fe (Leu)$_2$(Q)]	304 249	32894 40160	1937 398	5.45	${}^5T_2g \rightarrow {}^5Eg$ C.T
Na[Co(Leu)$_2$(Q)]	399 351 304	25062 28490 32894	1408 1442 1054	4.44	${}^4T_1g \rightarrow {}^4T_1\,g_{(P)}$ ${}^4T_1g \rightarrow {}^4A_2\,g_{(F)}$ C.T
Na[Ni(Leu)$_2$(Q)]	747 389 335 250	13386 25706 29850 4000	60 2272 2772 170	3.22	${}^3A_2g \rightarrow {}^3T_2\,g_{(F)}$ ${}^3A_2g \rightarrow {}^3T_1\,g_{(F)}$ ${}^3A_2g^3 \rightarrow T_1\,g_{(P)}$ C.T
Na[Cu((Leu)$_2$(Q)]	738 389 259	13550 25706 38610	150 1176 105	1.87	${}^2B_{1g} \rightarrow {}^2B_{2g}$ ${}^2B_{1g} \rightarrow {}^2A_{2g}$ Ligand field
Na[Zn(Leu)$_2$(Q)]	382 334 257	26178 29940 38190	1677 1401 117	Dima	C.T Ligand field Ligand field
Na[pd(Leu)$_2$(Q)]	412 261	24271 38314	462 92	Dima	C.T Ligand field
Na[pb (Leu)$_2$(Q)]	389 319	25706 31347	1870 1476	-	red shift($n \rightarrow \pi^*$) red shift ($n \rightarrow \pi^*$
Na[Sn (Leu)$_2$(Q)]	378 312	26455 32051	1235 1331	---	red shift($n \rightarrow \pi^*$ red shift($n \rightarrow \pi^*$

Proposed molecular structure :

The previous analysis we can conclude that the complexes have Octahedral geometry of the formula Na[M(Leu)$_j$(Q)] M (II)=Mn(II),Fe(II), Co(II),Ni(II),Cu(II), Zn(II), Pd(II),Sn(II), and Pb(II). The suggested geometrical structure were built with chem3D Figure 9

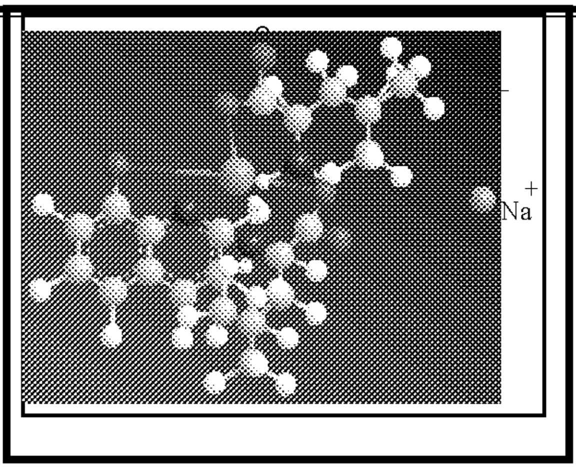


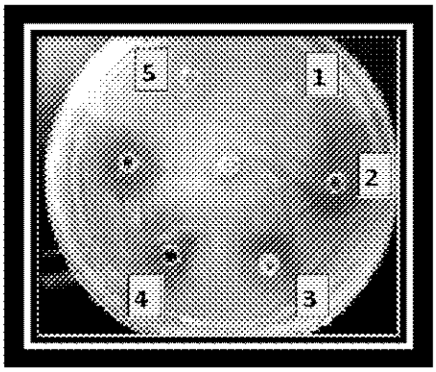
Figure **9:The suggested geometrical structure for the complexes Na[M(Leu)$_2$(Q)]**

M(II) =[Mn(II),Fe(II),Co(II), Ni(II),Cu(II), Zn(II), Pd(II),Sn(II)and Pb(II)]

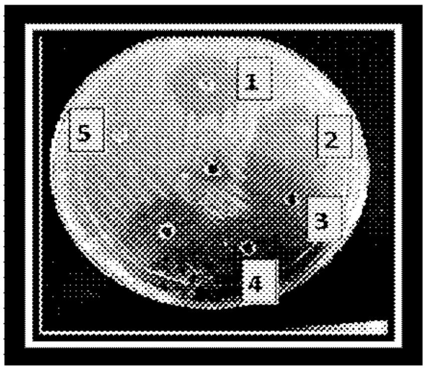
Table (6) Represents the antimicrobial activity of chemical compound

compounds	*Escherichia coli*	*Candida albicans*	*Pseudomonas*	**Bacillus**	*Staphylococcus S.P+*
(Control) DMf	**10**	**10**	**9**	**10**	**10**
L- Leu	**15**	**18**	**11**	**14**	**15**
Q	**20**	**25**	**12**	**22**	**20**
Na [Mn(Leu)$_2$(Q)], No(1)	**29**	**32**	**17**	**30**	**38**
Na [Sn(Leu)$_2$(Q)] No(2)	**25**	**30**	**11**	**34**	**37**
Na [Pd(Leu)$_2$(Q)] No(3)	**20**	**33**	**15**	**38**	**35**

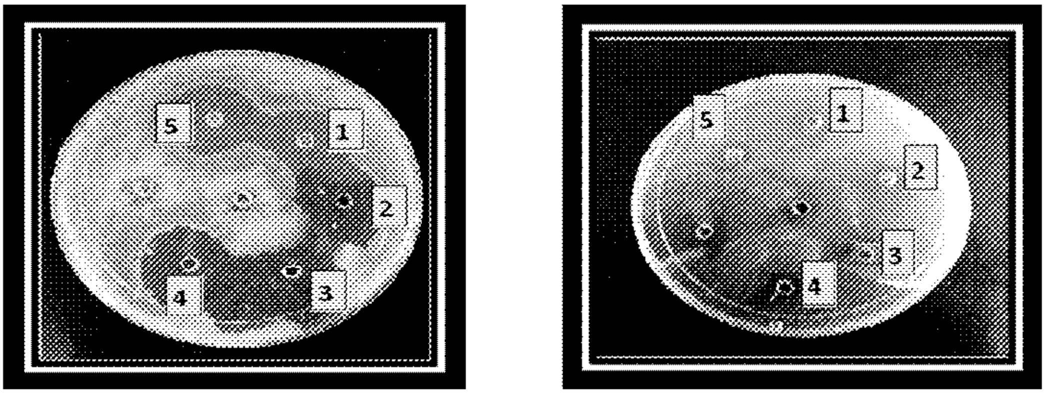
against some pathogenic bacteria



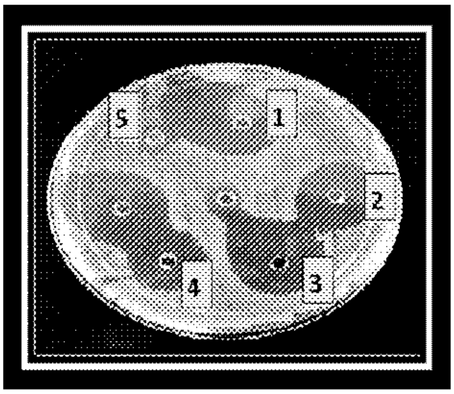
Eschericha coli



Staphylococcus aureus



dida albicans ***Bacillus cereus***



Pseudomonas aeruginosa

Figure (10) shows the antimicrobial activity of chemical compounds (ligands,complex ,1,2,3) appear the inhibition zones against some pathogenic bacteria

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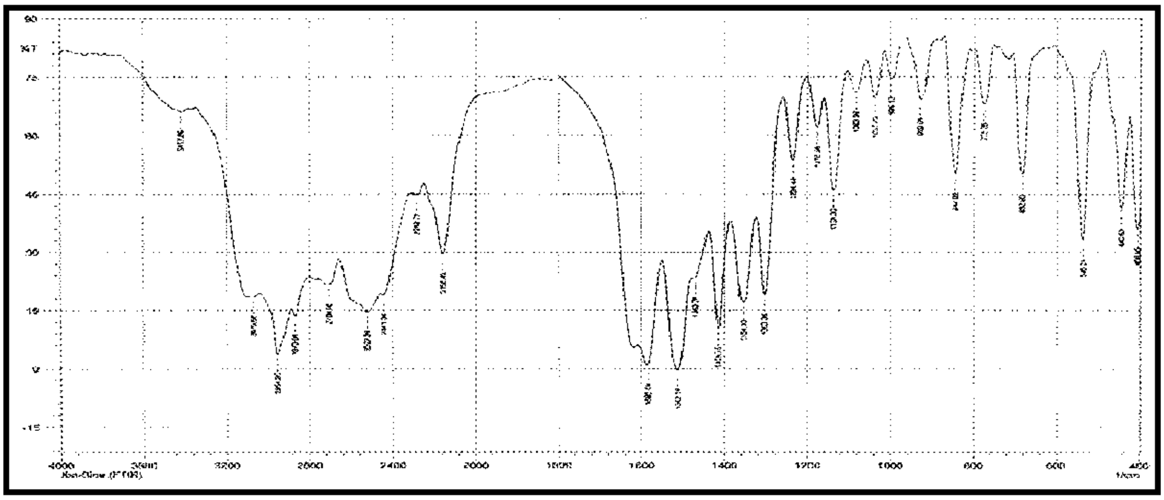


Figure .(1) FT- IR Spectrum of L-leucine $C_6H_{13}NO_2$

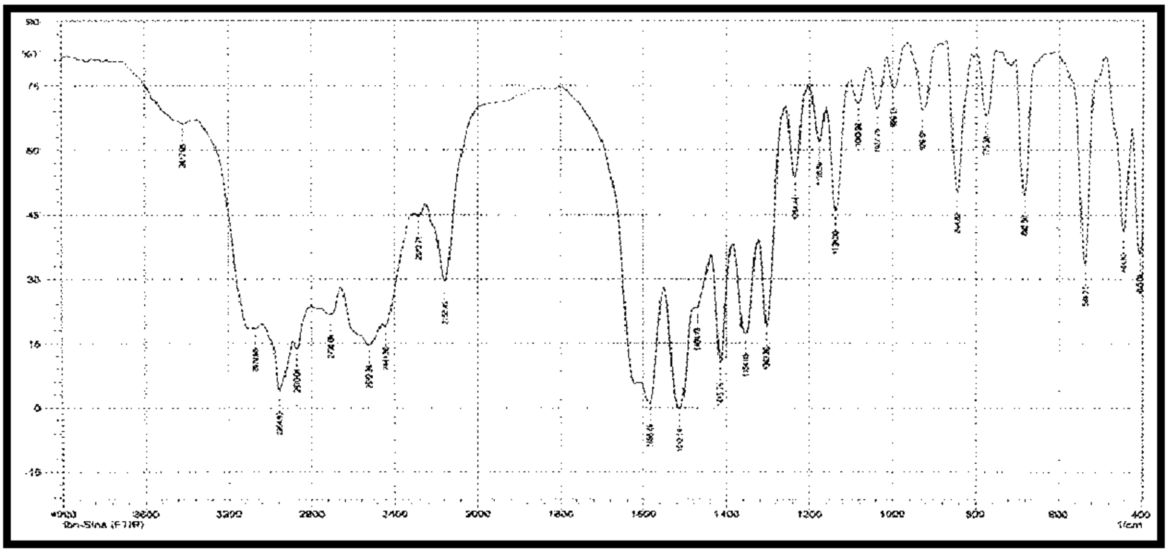


Figure (2) : FT-IR spectrum for (8-Hydroxyqinoline)

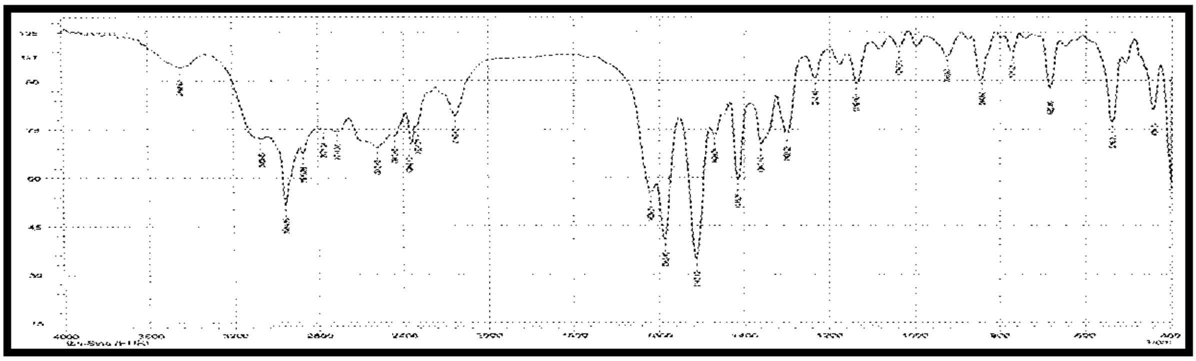
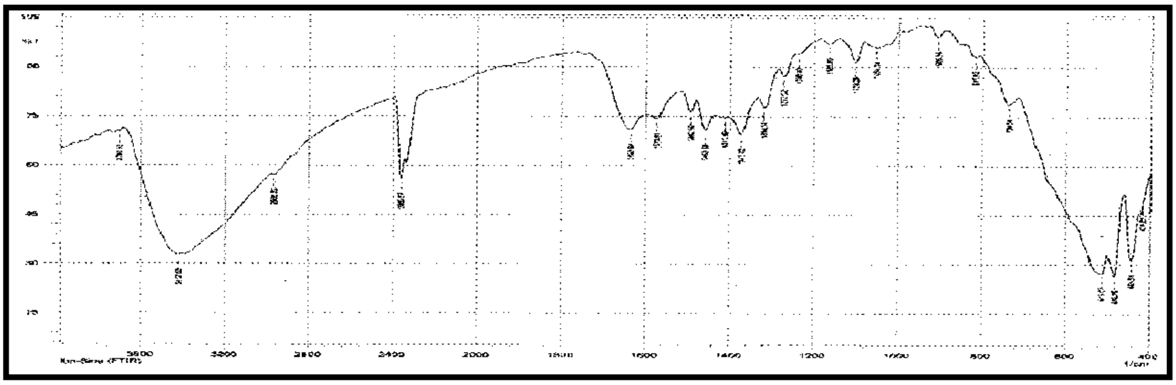


Figure (3): FT-IR spectrum for $Na[Mn(C_9H_6NO)(C_6H_{12}NO_2)_2]$



$])_2Na[Fe(C_9H_6NO)(C_6H_{12}NO$ Figure (4): FT-IR spectrum for

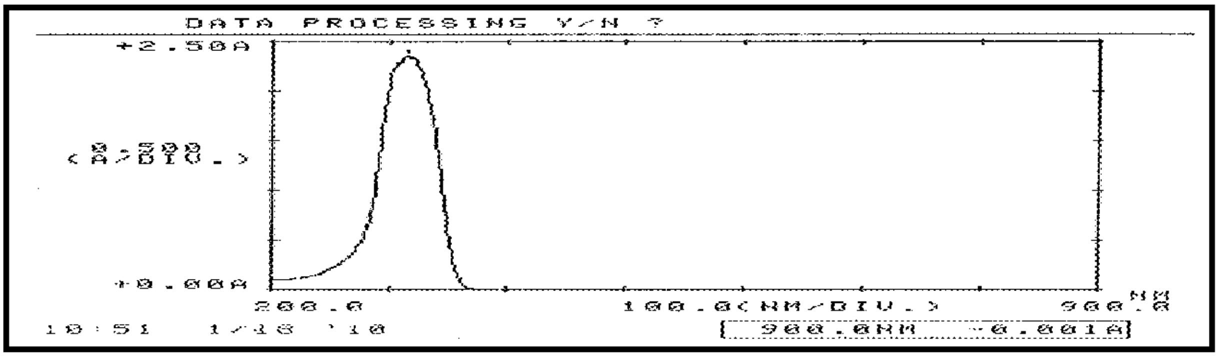
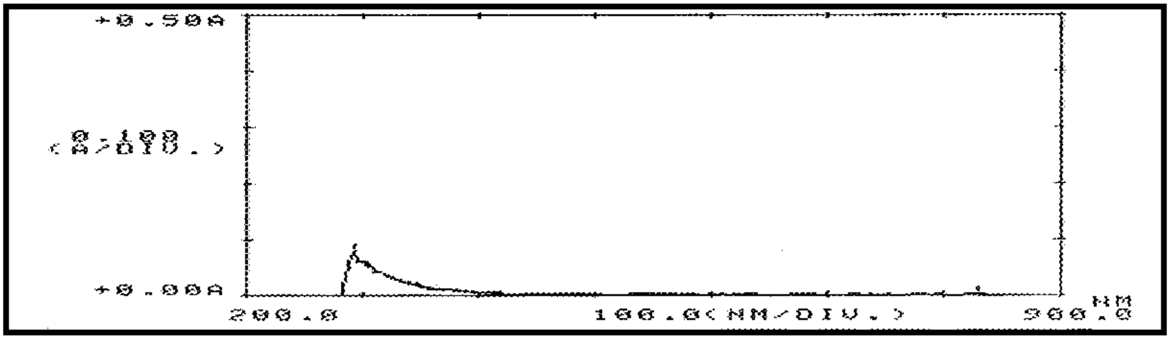
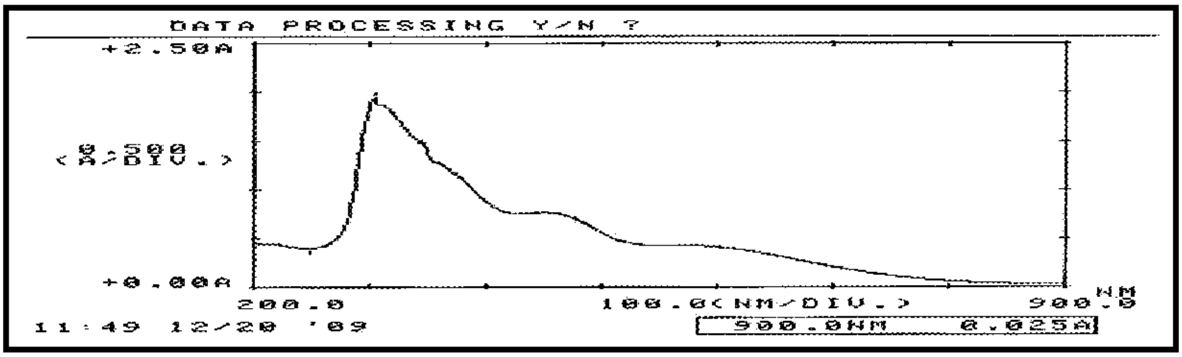


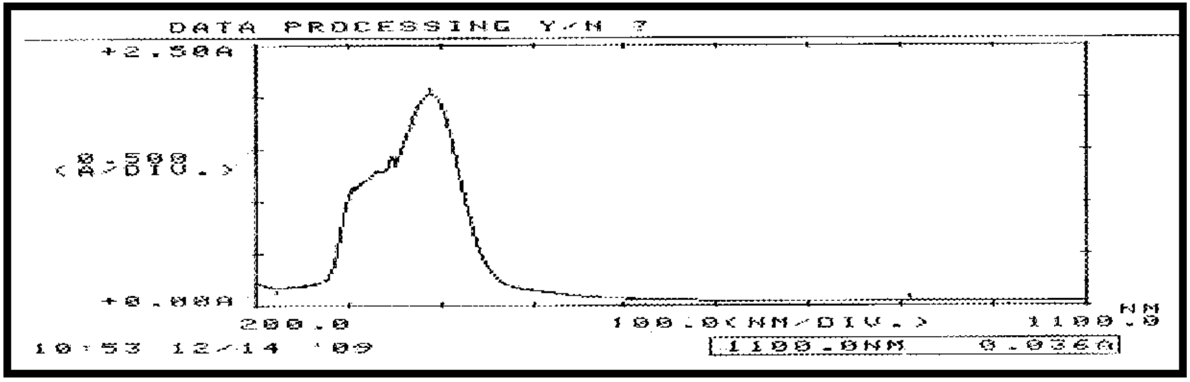
Figure (5): The (UV-Vis) Spectrum for (8-Hydroxyqinoline)



Figure(6)The (UV-Vis) Spectrum for L-leucine



Figure(7) The (UV-Vis) Spectrum for Na[Mn $(C_9H_6NO)(C_6H_{12}NO_2)_2$]



$[Fe(C_9H_6NO)(C_6H_{12}NO_2)_2]$ Na Figure (8)The (UV-Vis) Spectrum for

مختلطة الليكاند من تحضير ،تشخيص ودراسة الخواص الضديدة للبكتريا لمعقدات (الليوسين و8-هيدروكسي كوينولين) مع بعض أيونات العناصر الفلزية

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الخلاصة

يتضمن البحث تحضير وتشخيص معقدات للايونات M^{+2} مختلطة الليكاند بالصيغة العامة : **Na[M(Leu)$_2$(Q)]** باستعمال الحامض الاميني (الليوسين) ليكانداً أولي والليكاند (8-هيدروكسي كوينولين) ليكانداً ثاني إذ ان الليوسين ($C_6H_{13}NO_2$) بالرمز(LeuH) و8-هيدروكسي كوينولين (C_9H_7NO) بالرمز (8-HQ) وذلك بمفاعلة الليكاندان مع كلوريدات العناصر باستعمال الايثانول مذيباً وفي درجة حرارة المختبروبنسب مولية [(1:1:2) (metal) : Q^- : 2Leu $^-$] مع M(II) إذ إن:

M(II) =[Mn(II), Fe(II),Co(II), Ni(II),Cu(II), Zn(II), Pd(II),Sn(II) و P b(II)]