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**SYNTHESIS AND CHARACTERIZATION OF Mn⁺², Co⁺², Ni⁺², Cu⁺²
AND Zn⁺² COMPLEXES WITH 4-(2-(BENZO-1,3-DIOXOL-5-YL)-4,5-DIPHENYL-2,5-
DIHYDRO-1H-IMIDAZOL-1-YL)ANILINE AND EVALUATION OF THEIR
BIOLOGICAL ACTIVITY**

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Abstract: The aim of this work was to create new ligand complexes and evaluate their effectiveness against certain strains of bacteria. A Bruker Tensor 27co FTIR spectrophotometer was used to record the infrared spectra. Elemental analysis (C, H, N) was carried out on an AA670 atomic absorption spectrophotometer to determine mineral content, and the conductivity of PCM3 Jenway was measured to record electronic spectra. The ligand was prepared, that possessed physical constants and spectroscopic properties. The complexes [M(L)₂Cl₂] and [M(L)₄Cl₂] were also prepared, where M=Mn(II), Co(II), Ni(II), Cu(II), and Zn(II), which were synthesized by direct reaction of the above ligand with metal chlorides in (2:1) or (4:1) (Ligand : metal) molar ratio in the ethanol medium. The ligand compound 4-(2-(benzo-1,3-dioxol-5-yl)-4,5-diphenyl-2,5-dihydro-1H-imidazol-1-yl)aniline (L) was obtained. The prepared complexes were shown by elemental analysis, spectroscopic studies (FTIR, UV/vis), 1H-NMR measurement, conductivity measurements, and electron spectrometry value, which indicate the presence of tetrahedral and octahedral geometry around the metal ions. The biological antibacterial activity of the compounds and complexes has been demonstrated against specific strains of G⁺ Staph. aureus and G⁻ Bacillus. The bonding compound L coordinates the metal in a tetrahedral and octahedral N-M-N manner. The compound and its complexes had activity against specific strains of bacteria. The ligand (L₁) and the complex (3) had a greater effect on different types of bacteria than the rest of the complexes, which had a lower efficiency rate.

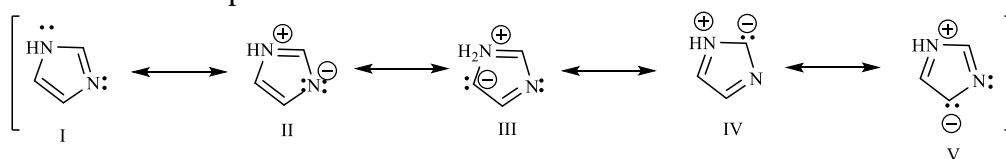
Keywords: imidazole, ligand, ethanol medium, direct reaction.

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Introduction

Imidazole is a pentagonal, planar heterocyclic compound that has the molecular formula (C₃N₂H₄), and its structure contains two nitrogen atoms at 1 and 3 positions. Imidazole

belongs to the aromatic heterocyclic compounds because it fulfills a Huckel base, as shown in the following main formulas [1]:



is more basic than pyrrole, but it has the amphoteric property of dual acidic and

basic behavior, as it can form salts with strong acids and also reacts with bases quickly, as in

pyrrole. This behavior has a major impact in giving the pyrrole ring a polar character that makes it dissolve quickly in all polar solvents, as it has a dipole moment of (3.61).

Due to their diverse and distinct properties, the imidazole compounds have gained great importance since their discovery until now. They are an important part of the synthesis of many natural compounds such as vitamin (B12) as well as the amino acid histidine. They are also involved in the synthesis of the nitrogenous base purine [2].

The human need to prepare medicinal compounds that possess antibiotic properties is increasing. This is considered one of the greatest challenges of the era, as it cannot be certain that all prepared chemical compounds possess antibiotic properties, as some of them have a high toxicity characteristic that hinders their use as antibiotics. Heterocyclic compounds are among the most common chemical compounds. The preparation has an antidote effect in various fields, as it contains within its composition heterogeneous atoms that can engage in complex biological mechanisms in the treatment of various and varied pathological conditions [3]. Perhaps one of the most important of these pharmaceutical compounds that enter a ring is Imidazole in its general structure. Conjunctival imidazole derivatives have shown efficacy clear in the treatment of cancerous diseases[4-6]. Imidazole compounds showed clear activity as anti-tubercular [7-9]. In addition to the use of imidazole derivatives as anti-fungal [10] antiparasitic [11], anti-obesity [12], they are also effective in the treatment for

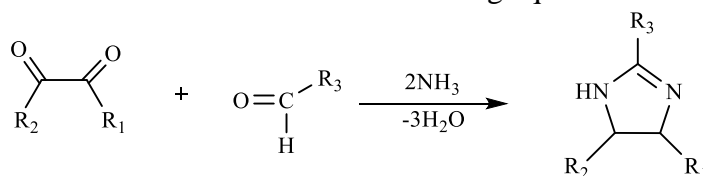
blood pressure diseases (anti-hypertensive) [13] and antidiabetic agents [14], and in the treatment of nerve inflammation (anti-inflammation of the nerves) [15].

Industrially, imidazole compounds have received great interest due to their use to improve the mechanical properties of polymers[16] and are also used in treating epoxy resin [17]. In addition, they are used in the manufacture of electrical circuits [18] and also as an anti-corrosion coating for copper [19]. Imidazole substitutes have recently been used as secondary catalysts in the chemical industries, especially in organic chemical reactions [20].

Imidazole compounds have had a significant impact on the agricultural field, as their derivatives were used in the manufacture of special types of pesticides and fertilizers that work to increase the resistance of plants to harsh environmental conditions [21].

Nowadays, imidazole compounds are prepared by many and varied methods, but the first to discover and prepare them was the scientist Hatzesh in 1858 AD [22]. He used dicarbonyl compounds in the presence of ammonia and aldehyde compounds to obtain tri-imidazole, as shown in the following equation:

Nowadays, imidazole compounds were prepared in many and varied ways, but they were first discovered and prepared by the scientist Hattzesh in 1858 AD [22]. He used dicarbonyl compounds in the presence of ammonia and aldehyde compounds to give the triple-substituted imidazole, as shown in the following equation:



This reaction was the first stage in the discovery of multi-component reactions in preparation of the heterocyclic compound, especially imidazole, as many of its derivatives were subsequently prepared in different and varied ways. Thus, in 1998, Sisko and his group made substituted imidazoles fused with heterogeneous hexagonal rings. He adopted Van Lozen's principle in preparing imidazole derivatives, but he used Schiff's rules for replacing them with saturated heterocyclic

compounds and cyanide compounds replacing them with an aromatic ring [23, 24].

Conjugated imidazole derivatives were prepared from multicomponent reactions [25]. Continuously with the development of the synthetic formula for imidazole substitutes through the preparation of conjugated imidazole compounds with high pharmaceutical efficacy, Helman and Molner were able in (2012 AD) to use microwave irradiation (MWI) technology in the preparation of tertiary conjugated imidazole

compounds and compared them with common traditional methods of preparation. They discovered the efficiency of the irradiation method in preparing these derivatives in terms of the product percentage, high purity, and short reaction time [26].

Imidazole compounds have been prepared from other different conjugated compounds [27]. Quaternary imidazole substitutes were prepared using multi-component, one-step reactions, in a neutral medium, and in the presence of potassium permanganate as a selective catalyst [28]. Recently, organic catalysts have attracted the attention of many researchers in adopting them in organic preparation, due to their simplicity, ease of use, and high effectiveness, in addition to their high solubility in organic solvents. The method of

condensing benzoin with aldehyde substitutes and ammonium acetate in the presence of amino compounds represented by nitrile amine and aniline and its substitutes in the presence of niacin (3-Picolinic acid) has been adopted in its preparation [29].

Therefore, we decided in this research to prepare new complexes of ligands that were synthesized and characterized by different physio-chemical techniques and spectroscopic measurements. Measurements demonstrated the binding of ligands to transition metals via nitrogen atoms producing two types of complexes $[M(L)_2Cl_2]$ and $[M(L)_4Cl_2]$ $M = Mn(II), Co(II), Ni(II), Cu(II),$ and $Zn(II)$. The ligands and complexes were evaluated against Gram (+) and Gram (-) bacteria, and the results were compared to the test drug.

Experimental part

All chemicals were of high grade and purchased from commercial sources (BDH and Fluka).

Physical characterization

The spectrophotometer Brucker Tensor 27co FTIR was used for record infrared radiation spectra in the 200 to 4000 cm^{-1} range using CsI discs. The elementary analyses (C, H, N) brought out use micro-analytical techniques on the elemental (CHN) Analyzer LCHN-ALO (Labtrone, UK). Metal content was determined by spectrophotometer by use AA670 atomic absorption. Conductivity measurement was carried out on 10^{-3} M solution of complexes in DMSO using conduction meter PCM3 Jenway at ambient temperature. Electronic spectra were recorded on a Shimadzu UV-visible spectrophotometry UV-160 for 10^{-3} M solution of the composite in DMSO at 25°C

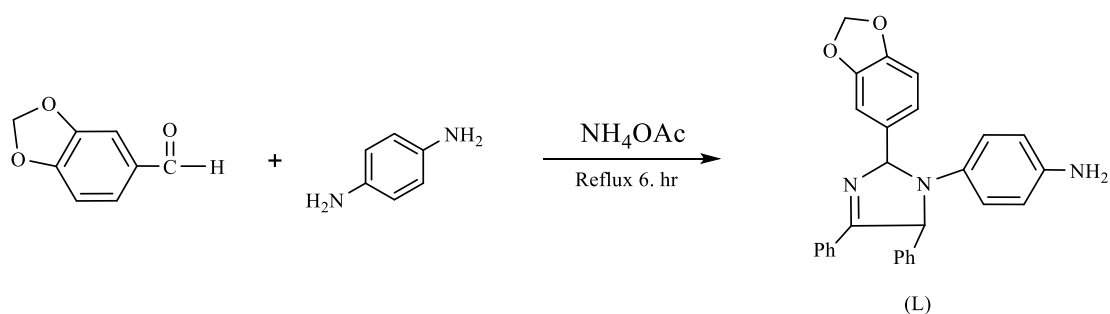
Preparation of the ligands

In a glass conical flask with a capacity of (100 ml), stoichiometric moles (0.01 mol) of piperonal, benzyl diketone, and paraphenylenediamine are dissolved in the presence of ammonium acetate (0.04 mol) in (25 mol) of

absolute ethyl alcohol in an acidic medium (5 ml) of glacial acetic acid. Reactant mixture is heated for (6 hours), cooled, poured into ice water (5 ml), and stirred well to complete the precipitation process. Then the obtained sediment is filtered and washed several times with the ice water 5×5 ml to withdraw acid constituted during the reaction, the precipitate is dried and recrystallized with absolute ethyl alcohol to give a brown-colored precipitate that possesses the physical constants and spectral properties mentioned above in the method.

Preparation of the Complexes $[M(L)_2Cl_2]$ and $[M(L)_4Cl_2]$, where $M=Mn(II), Co(II), Ni(II), Cu(II),$ and $Zn(II)$

Complexes were prepared according to the following method. The metal salts (0.01 mol) in ethanol (10 cm^3) were added to the ligand L (0.86 g, 0.02 mol) or (1.72 g, 0.04 mol) in ethanol (10 cm^3). Mixture was stirred under reflux for 2h. to ensure the completion of the reaction. Solids thus gained filtering off, washing with the ethanol, methanol, and diethyl ether, then dry according to vacuum.



Results and discussion

The synthetic ligand (L) (scheme 1) forms ten stable complexes with Mn(II), Co(II), Cu(II), Ni(II), and Zn(II) at molar ratios of (1:2) and (1:4), respectively. All of the complexes are soluble in many organic solvents and stable in dry air, with melting points ranging from 235 to 290°C. Table one contains the data from both the analytical and physical properties of the

substances. Complex analytical data are consistent with the suggested formulas $[M(L)_2Cl_2]$ and $[M(L)_4Cl_2]$. The molar conductance values of complexes in DMF and DMSO indicate that L complexes (1:2) and complexes (1:4) were nonelectrolytes. The proposed structure of prepared complexes appears in (Fig1).

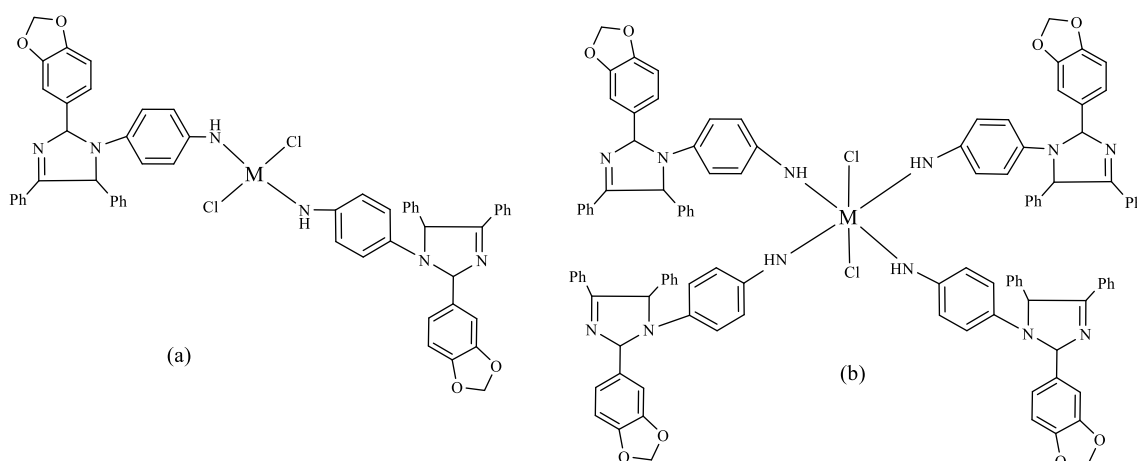


Fig. 1. The hypothesized structure of $[M(L)_2Cl_2]$ (a) and $[M(L)_4Cl_2]$ (b) complexes. M = Mn(II), Co(II), Ni(II), Cu(II), and Zn(II)

Table 1. The Physical characteristic of prepared ligands and complexes

Seq.	Compound	Color	m.p (°c)	Yield %	Analysis \ found (calc.)%					(Λ) $cm^2 \cdot ohm^{-1} \cdot mol^{-1}$
					C	H	N	M	Cl	
L	$C_{28}H_{22}N_3O_2$	brown	235-238	89	77.84 (77.81)	5.09 (5.30)	9.72 (9.29)	----	---	---
1	$[Mn(L)_2Cl_2]$	brown	290 ^d	74	68.08 (65.87)	4.25 (4.04)	8.50 (7.96)	5.56 (5.19)	48.35 (47.45)	21.9
2	$[Co(L)_2Cl_2]$	Pale brown	276 ^d	93	67.81 (67.65)	4.23 (4.98)	8.47 (8.61)	5.94 (5.54)	30.94 (29.87)	22.5
3	$[Ni(L)_2Cl_2]$	Dark brown	285 ^d	89	67.83 (62.46)	4.23 (5.02)	8.47 (7.36)	5.91 (5.38)	31.61 (30.95)	22
4	$[Cu(L)_2Cl_2]$	Dark green	259 ^d	83	67.50 (64.20)	4.21 (4.68)	8.43 (8.09)	6.37 (6.09)	40.58 (39.66)	30
5	$[Zn(L)_2Cl_2]$	Pale brown	283-285	72	67.37 (68.65)	4.20 (3.87)	8.41 (7.98)	6.54 (6.13)	36.08 (35.98)	-----

Seq.	Compound	Color	m.p (°c)	Yield %	Analysis \ found (calc.)%					(Λ) cm ² .ohm ⁻¹ .mol ⁻¹
					C	H	N	M	Cl	
6	[Mn(L) ₄ Cl ₂]	Brown	280 ^d	95	72.72 (69.77)	4.54 (3.65)	9.08 (8.56)	2.96 (2.56)	48.77 (47.92)	31
7	[Co(L) ₄ Cl ₂]	Dark brown	256 ^d	96	72.56 (68.65)	4.53 (4.90)	9.06 (8.54)	3.17 (2.97)	41.33 (40.94)	30
8	[Ni(L) ₄ Cl ₂]	Pale brown	266 ^d	88	72.57 (67.77)	4.53 (4.91)	9.06 (8.46)	3.17 (2.78)	38.39 (37.91)	28
9	[Cu(L) ₄ Cl ₂]	Dark brown	245 ^d	90	72.38 (70.76)	4.51 (4.68)	9.04 (8.73)	9.42 (8.78)	38.79 (38.43)	23
10	[Zn(L) ₄ Cl ₂]	Pale brown	267 ^d	82	72.31 (71.87)	4.51 (3.59)	9.03 (8.78)	3.52 (3.01)	35.90 (35.11)	-----

d= decomposition temperature

¹H-NMR spectra.

The ¹H- NMR spectra of L registered in DMSO – d⁶ solvent and ¹H- NMR assignments

for the compounds are presented in (Table 2) and (Fig. 2) [30].

Table 2. ¹H-NMR data of ligands

L	ζ(ppm)	Assignment
	5.33	NH ₂ (s, 1H)
	6.02	CH ₂ -piperonal(s,2H)
	6.42-6.46	p-amino(d-d,4H)
	6.86-6.91	Ph-piperonal (m,3H)
	7.15-7.50	2phenyl ring (m,10H)

S=singlets, M=multiplets

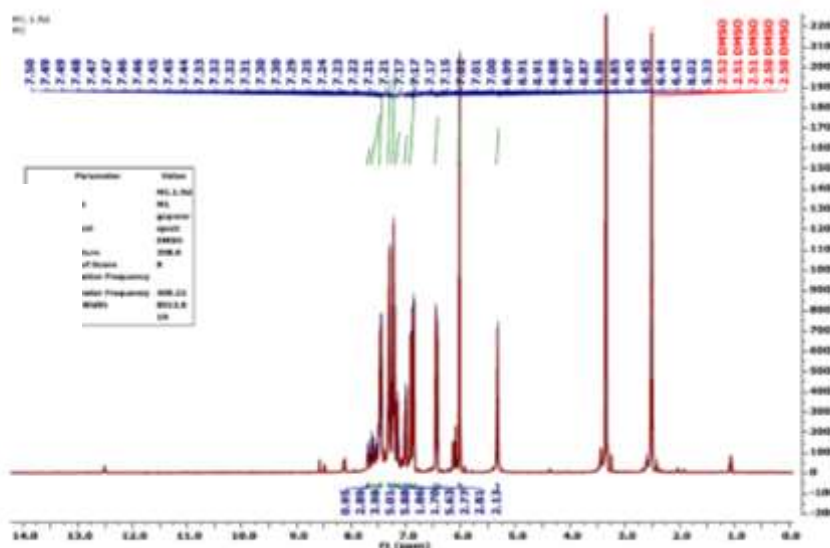


Fig. 2. ¹H-NMR spectra of L

IR- spectra.

The IR spectral study tried for all prepared compounds. A kind of bond of ligand and metal can be established by IR spectra. The band at (3357) cm⁻¹ in IR spectra of L supported the formation of ν(NH₂) [31]. The bands received

for ν(C=N) at 1511 cm⁻¹. This band disappear in the spectrum complexes [32], while a new band at (3417-3487) cm⁻¹ in IR spectra of complexes supported the formation of (N-H) which indicates the participant of the nitrogen atom of imidazole group in bonding [33].

On other hand on spectrum of all complexes a new bands appeared (427-477) cm^{-1} due to ν (M-N) for (2:1) and (4:1) spontaneously stretching vibration [34]. ν (M-Cl) band is not registered because this band below to spectrophotometer limit. This

discussion suggested that L coordinates to metal in tetra dentate and octahedral fashion N-M-N [35]. The results were mentioned in the following (Table 3) and shown in (Fig. 3 and 4)

Table 3. Personalized IR bands of L and their complexes

No	Compounds	ν (C=N)	ν (NH)	N (M-N)
L	$\text{C}_{28}\text{H}_{22}\text{N}_3\text{O}_2$	1511	----	---
1	$[\text{Mn}(\text{L})_2\text{Cl}_2]$	1515	3444	468
2	$[\text{Co}(\text{L})_2\text{Cl}_2]$	1516	3479	467
3	$[\text{Ni}(\text{L})_2\text{Cl}_2]$	1517	3417	469
4	$[\text{Cu}(\text{L})_2\text{Cl}_2]$	1513	3487	451
5	$[\text{Zn}(\text{L})_2\text{Cl}_2]$	1515	3445	449
6	$[\text{Mn}(\text{L})_4\text{Cl}_2]$	1515	3444	427
7	$[\text{Co}(\text{L})_4\text{Cl}_2]$	1516	3478	477
8	$[\text{Ni}(\text{L})_4\text{Cl}_2]$	1516	3444	477
9	$[\text{Cu}(\text{L})_4\text{Cl}_2]$	1514	3446	476
10	$[\text{Zn}(\text{L})_4\text{Cl}_2]$	1516	3479	477

Table 4. UV spectra of compounds

No	Compounds	Band maxima λ cm^{-1}	Structure
L ¹	$\text{C}_{28}\text{H}_{22}\text{N}_3\text{O}_2$	32467	---
1	$[\text{Mn}(\text{L})_2\text{Cl}_2]$	35432	Td
2	$[\text{Co}(\text{L})_2\text{Cl}_2]$	37217	Td
3	$[\text{Ni}(\text{L})_2\text{Cl}_2]$	37037	Td
4	$[\text{Cu}(\text{L})_2\text{Cl}_2]$	31847	Td
5	$[\text{Zn}(\text{L})_2\text{Cl}_2]$	36986	Td
6	$[\text{Mn}(\text{L})_4\text{Cl}_2]$	35689	Oct
7	$[\text{Co}(\text{L})_4\text{Cl}_2]$	37268	Oct
8	$[\text{Ni}(\text{L})_4\text{Cl}_2]$	37313	Oct
9	$[\text{Cu}(\text{L})_4\text{Cl}_2]$	37313	Oct
10	$[\text{Zn}(\text{L})_4\text{Cl}_2]$	36589	Oct

Ultraviolet visible (UV).

Electronic spectra are valuable in explaining the structure; measurement results are shown in Table 4. The electronic spectra of the ligands in DMSO shown aromatic in the tenses band at 306 (nm) assigned to intra-ligand charge transfer (LCT) transition (π - π^*) because transitions related molecular orbital situating in the benzene ring of the ligand group at 326 (nm) attribute (n - π^*) transition because the transitions of the imidazole groups are also founding in the spectra of the complexes but they are shifted, and confirm coordinate of ligands to the metallic ions. The recent intensifying band in

the spectra of all the complexes at (31847-37313) cm^{-1} could be attributable to the LMCT transition [36].

The electronic spectra of the Mn(II) complex (1) reveal no prominent absorption that might be attributed to the d-d transition. The d-d transition in the Mn(II) tetrahedral environment is spin-forbidden but no extended parity is forbidden. These transitions are ~100 times stronger. The structure of the formulated Mn(II) complex was projected based on data from various measurements [37].

Electronic spectra of Mn (II) complex(6) were appeared absorption bands at (19764) cm^{-1}

¹, (24611) cm⁻¹, and (27499) cm⁻¹ assignable to ⁶A_{1g}→⁴T_{1g}(⁴G), ⁶A_{1g}→⁴A_{1g}(⁴G) and ⁶A_{1g}→⁴E_g(⁴D), respectively. These bands agree with the octahedral structure [38, 39].

In Co (II) complex (2) the electronic spectra exhibit one transition ν_3 ⁴A₂(F)→⁴T₁(P) consisting of the two humps locate at (14947) cm⁻¹. The split of this band is expected owing to the distorting of Jahn-Teller type of tetrahedral structure in the excited state [40], whereas the other two bands ν_1 and ν_2 are below the threshold limit.

Electronic spectra Co(II) complex (7) it's showing bands at 10191 cm⁻¹, 16249 cm⁻¹ and 19450 cm⁻¹ assignable to ⁴T_{1g}(F)→⁴T_{2g}(F), ⁴T_{1g}(F)→⁴A_{2g}(F) and ⁴T_{1g}(F)→⁴T_{1g}(p) respectively, these observation indicating an octahedral geometry around Co(II) ions [41].

In Ni (II) complex (3) the electronic spectra show a band ν_3 at (14664) cm⁻¹ due to ³T₁(F)→³T₁(P) transition in the tetrahedral geometry [42], other two bands ν_1 and ν_2 locating in lower section of spectra, are below spectrophotometer limit.

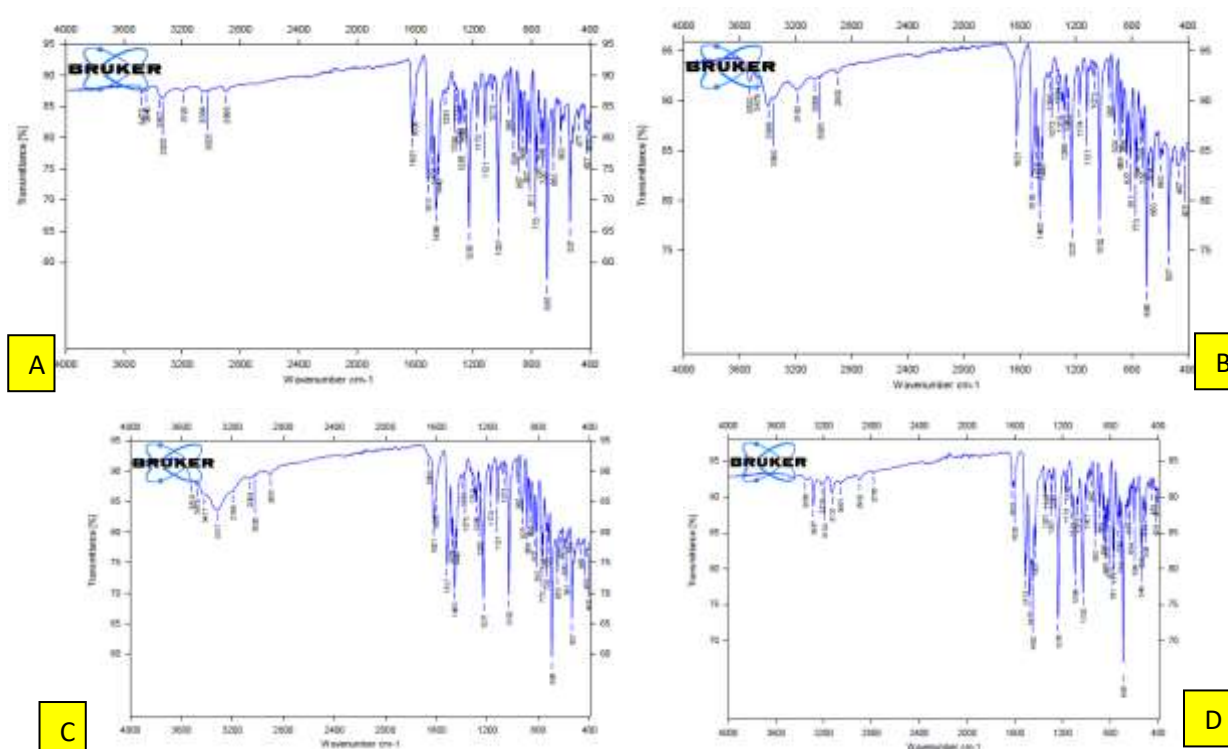


Fig 3. The IR spectrum of L (a), [Co(L)₂Cl₂] (b), [Ni(L)₂Cl₂] (c), and [Cu(L)₂Cl₂] (d).

Electronic spectra of Ni(II) complex (8) complex show three bands at the region (10325) cm⁻¹, (15688) cm⁻¹ and (23987) cm⁻¹ assigned to ³A_{2g}(F)→³T_{2g}(F), ³A_{2g}(F)→³T_{1g}(F) and ³A_{2g}(F)→³T_{1g}(p) transition, respectively. This show that the Ni(II) ions have an octahedral geometry [43].

In the electronic spectrum of Cu(II) complex (4) a wide band was seen at (14789) cm⁻¹ attributed to ²T₂→²E transitions that are analogous to complexes that have tetrahedral structures [44].

The electronic spectra of Cu(II) complex

(9) showing overseas absorption band at the 15577 cm⁻¹ and 15170 cm⁻¹ arises from two or three d-d transition ²B_{1g}→²A_{1g}, ²B_{1g}→²B_{2g} and ²B_{1g}→²E_g suggest that Cu(II) ion exhibits octahedral pattern [45, 46].

The electronic spectrum of Zn(II) complexes (5) and (10) shows only a band at (36986 - 36589) cm⁻¹ which represents the charge transfer spectra. It can be concluded, that complex (5) takes the tetrahedral geometry, while complex (10) has octahedral geometry [47].

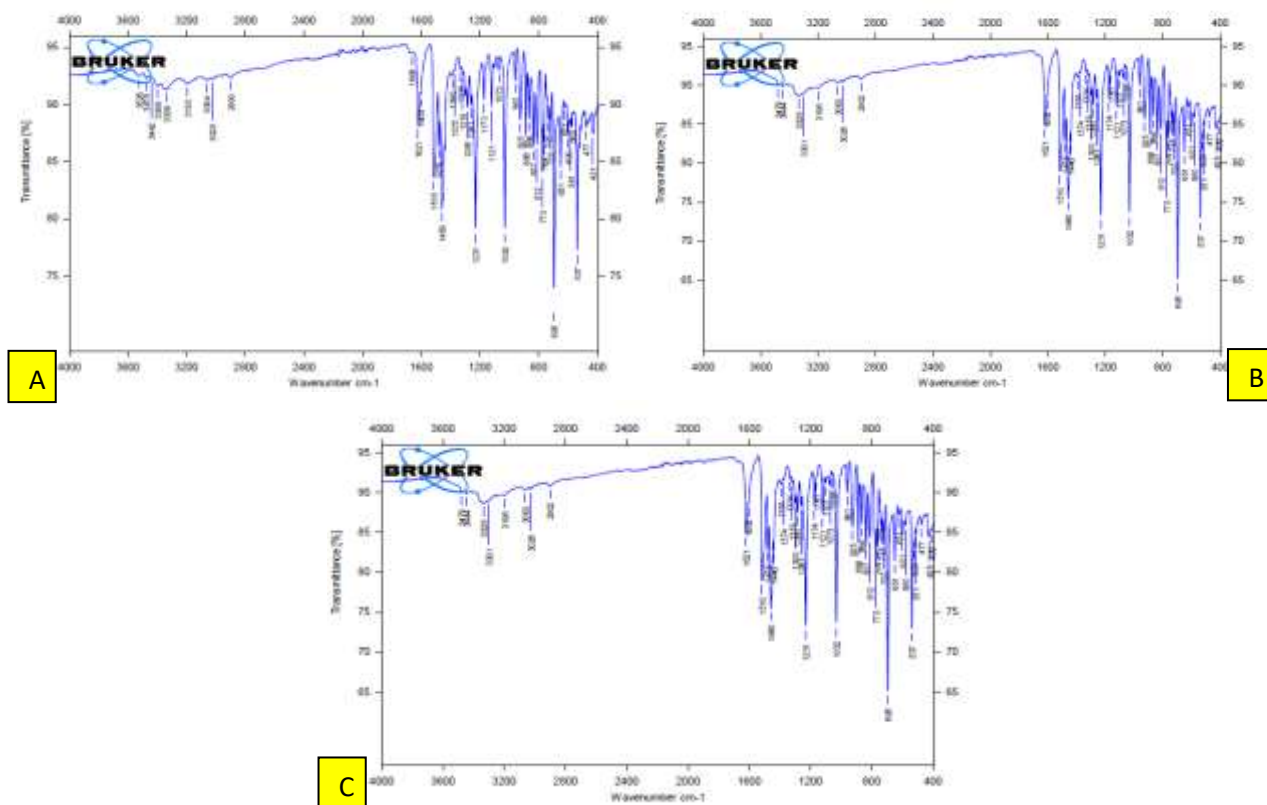


Fig 4. The IR spectrum of $[\text{Co}(\text{L})_4\text{Cl}_2]$ (a), $[\text{Ni}(\text{L})_4\text{Cl}_2]$ (b), $[\text{Cu}(\text{L})_4\text{Cl}_2]$ (c)

Table 5. Antimicrobial action of the ligands and their complexes

No.	Symbol	compound	Staphylococcus aureus (mm)	Bacillus subtilis (mm)
L	L1	$\text{C}_{28}\text{H}_{22}\text{N}_3\text{O}_2$	19	14
2	L1C	$[\text{Co}(\text{L})_2\text{Cl}_2]$	16	10
3	L1A	$[\text{Ni}(\text{L})_2\text{Cl}_2]$	18	11
4	L1E	$[\text{Cu}(\text{L})_2\text{Cl}_2]$	15	12
7	L1C4	$[\text{Co}(\text{L})_4\text{Cl}_2]$	15	12
8	L1A4	$[\text{Ni}(\text{L})_4\text{Cl}_2]$	14	13
9	L1E4	$[\text{Cu}(\text{L})_4\text{Cl}_2]$	14	11
Control			20	18

Antibacterial activity.

Estimation of the biological activity for ligand and the complexes was explored versus select kind of G(+) bacterium *Staphylococcus aureus* and G(-) bacteria *Bacillus subtilis*. The obtained results are tabulated and shown in

(Table 5), (Fig. 5) and (Graph 1) and compare with standard drugs (Ciprofloxacin). Evaluation showed that ligand and their complex have an activity described as less than effective of ciprofloxacin against the bacteria, used in this research [48].

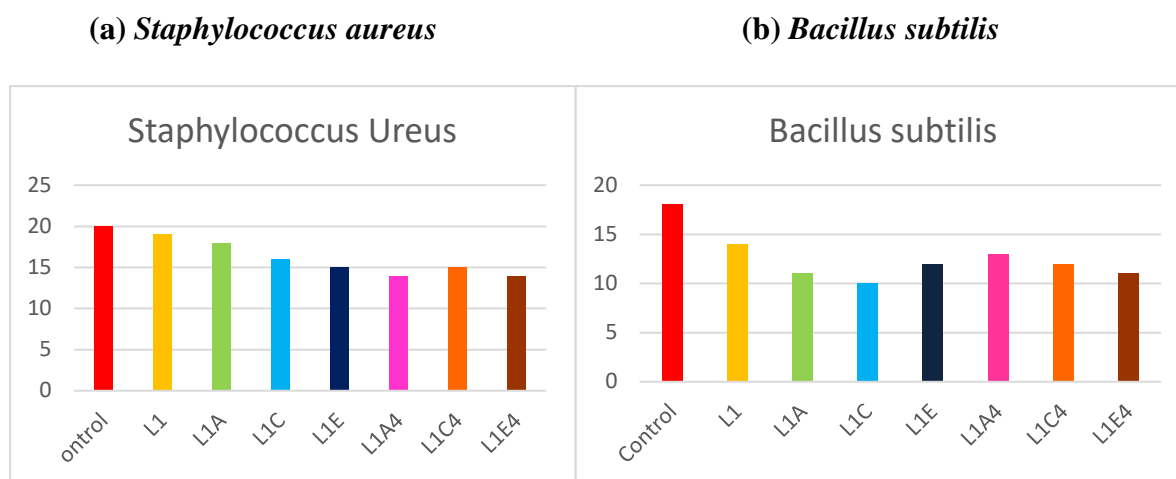
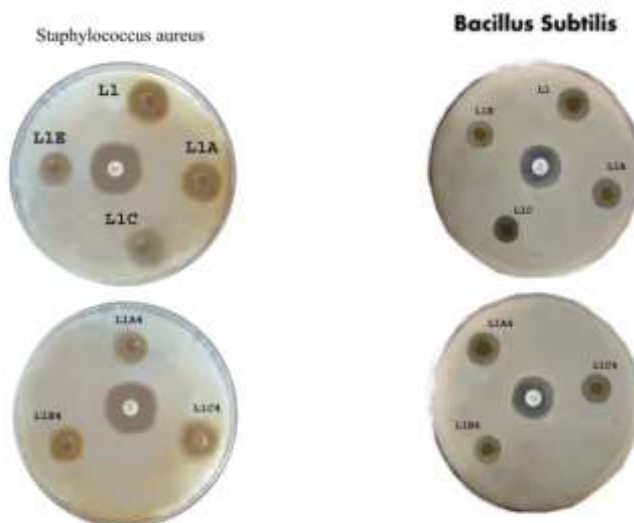


Fig. 5. Antibacterial activity of compounds agents (a) *Staphylococcus aureus* (b) *Bacillus subtilis*



Graph 1. Antibacterial activity of compounds

Conclusion

The literature has shown that there are numerous studies on regular metallic arrangements containing heterocyclic rings, which are important in the chemistry of ultra-ordinary macromolecules. The importance of these complexes is not only because their compositions are unexpected, but also because they are of medicinal therapeutic importance for some cancer diseases, have high antibacterial

effectiveness, are used in bioinorganic chemistry, and are similar to some enzymes, are used in separation processes, and are important agent in oxygen transfer processes in mammals and some respiratory systems. Therefore, we decided in this research to prepare some new heterocyclic ligands as well as their complexes with metal ions Cu(II), Ni(II), Zn(II), Co(II), and Mn(II).

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4-(2-(BENZO-1,3-DİOKSOL-5-YL)-4,5-DİFENİL-2,5-DİHİDRO-1H-İMİDAZOL-1-İL)ANİLİNLƏ Mn⁺², Co⁺², Ni⁺², Cu⁺² VƏ Zn⁺² KOMPLEKSLƏRİNİN SİNTEZİ, XASSƏLƏRİ VƏ BİOLOJİ AKTİVLİKLƏRİNİN QIYMƏTLƏNDİRİLMƏSİ

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Хўласа: Ўшн мақсәди yeni liqand komplekslәri yaratmaq vә onların müәyyән bakteriya ştammlarına qarşı effektivliyini qiymәtlәndirmәkdir. Komplekslәrin infraqırmızı spektrlәrini qeyd etmәk үçün Brucker Tensor 27co FTIR spektrofotometrindән istifadә edilmiş, mineral tәrkibini müәyyән etmәk үçün AA670 atom udma spektrofotometrindә element analizi (C, H, N) aparılmış vә elektron spektrlәri qeyd etmәk үçün PCM3 Jenway-in keçiriciliyi ölçülmüşdür. Fiziki sabitlәrә vә spektroskopik xüsusiyyәtlәrә malik olan liqand hazırlanmışdır. $[M(L)_2Cl_2]$ vә $[M(L)_4Cl_2]$ komplekslәri dә hazırlanmışdır, burada $M=Mn(II)$, $Co(II)$, $Ni(II)$, $Cu(II)$ vә $Zn(II)$, yuxarıdakı liqandın etanol mühitindә (2:1) vә ya (4:1) (Liqand: metal) molyar nisbәtdә metal xloridlәrlә birbaşa reaksiyası nәticәsindә sintez edilmiş vә 4-(2-(benzo-1,3-dioksol-5-il)-4,5-difenil-2,5-dihidro-1H-imidazol-1-il)anilin (L) liqand birlәşmәsi әldә edilmişdir. Sintez edilmiş komplekslәр element analizi, spektroskopik tәdqiqatlar (FTIR, UV/vis), 1H -NMR ölçülmәsi, keçiricilik ölçmәlәri vә metal ionları әtrafında tetraedral vә oktaedral hәndәsәnin mövcudluğunu göstәрән elektron spektrometriya dәyәri ilә göstәrilmişdir. Birlәşmәlәrin vә komplekslәrin bioloji antibakterial fәaliyyәti xüsusi G+ Staph ştammlarına qarşı nümayiş etdirilmişdir: aureus vә G- Bacillus. Bağlayıcı birlәşmә L metalı tetraedral vә oktaedral N-M-N şәkildә әlaqәlәndirir. Mürәkkәb vә onun komplekslәri bakteriyaların spesifik ştammlarına qarşı aktiviyә malikdir. Liqand (L1) vә kompleks (3) daha az sәmәrәlilik dәрәcәsinә malik olan digәр komplekslәrә nisbәtән müxtәlif növ bakteriyalara daha çox tәsir göstәrmışdir.

Açar sözlәri: imidazol, liqand, etanol mühiti, birbaşa reaksiya.

**СИНТЕЗ И ХАРАКТЕРИСТИКА Mn^{+2} , Co^{+2} , Ni^{+2} , Cu^{+2}
И Zn^{+2} КОМПЛЕКСОВ С 4-(2-(БЕНЗО-1,3-ДИОКСОЛ-5-ИЛ)-4,5-ДИФЕНИЛ-2,5-
ДИГИДРО-1Н-ИМИДАЗОЛ-1-ИЛ)АНИЛИНОМ И ОЦЕНКА ИХ БИОЛОГИЧЕСКОЙ
АКТИВНОСТИ**

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Аннотация: Целью данной работы было создание новых лигандных комплексов и оценка их эффективности против определенных штаммов бактерий. Для регистрации инфракрасных спектров использовали FTIR-спектрофотометр Brucker Tensor 27co. Элементный анализ (C, H, N) проводился на атомно-абсорбционном спектрофотометре AA670 для определения содержания минералов, а проводимость РСМ3 Jenway измерялась для регистрации электронных спектров. Был получен лиганд, обладающий физическими константами и спектроскопическими свойствами. Были также получены комплексы $[M(L)_2Cl_2]$ и $[M(L)_4Cl_2]$, где $M=Mn(II)$, $Co(II)$, $Ni(II)$, $Cu(II)$ и $Zn(II)$, которые были синтезированы прямой реакцией указанного лиганда с хлоридами металлов в мольном соотношении (2:1) или (4:1) (Лиганд:металл) в среде этанола. Было получено лигандное соединение 4-(2-(бензо-1,3-диоксол-5-ил)-4,5-дифенил-2,5-дигидро-1H-имидазол-1-ил)анилин (L). Полученные комплексы были показаны с помощью элементного анализа, спектроскопических исследований (FTIR, UV/vis), измерения 1H -ЯМР, измерений проводимости и значений электронной спектроскопии, которые указывают на наличие тетраэдрической и октаэдрической геометрии вокруг ионов металлов. Биологическая антибактериальная активность соединений и комплексов продемонстрирована в отношении специфических штаммов G+ Staph. aureus и G- Bacillus. Связующее соединение L координирует металл

тетраэдрическим и октаэдрическим образом N-M-N. Соединение и его комплексы обладали активностью в отношении специфических штаммов бактерий. Лиганд (L1) и комплекс (3) оказывали большее влияние на разные виды бактерий, чем остальные комплексы, имеющие меньший показатель эффективности.

Ключевые слова: имидазол, лиганд, этанольная среда, прямая реакция.