



Preparation of New Complexes of Fe(II), Co(II), Ni(II) and Cu(II) with Mixed Ligands of Ciprofloxacin or Levofloxacin with Eugenol and Study of Their Chemical and Physical Properties



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Abstract:

Eight new mixed ligands metal complexes have been prepared by the reaction of Fe(II), Co(II), Ni(II) and Cu(II) with (1:1:1 molar ratio) of ciprofloxacin - eugenol or levofloxacin - eugenol mixed ligands in alkaline medium. The coordination of the mixed ligands toward metal ions has been anticipated in the light of elemental analysis, molar conductance, spectral infrared (IR), ultraviolet-visible (UV-Vis) and magnetic measurements were bidentate ligands. Electronic and magnetic data suggested the octahedral configuration for all these new complexes. The molar conductance data for the metal complexes show non-electrolytic behaviour in DMF solvent and non-electrolytic properties, also they were no conducting electrical current. The biological activity of the prepared complexes was studied with positive and negative Gram-positive bacteria and good antibacterial results.

Keywords: Eugenol, Ciprofloxacin, Levofloxacin, IR, UV, Spectrum of flame

1. Introduction:

Eugenol, which is the first ligand used in this work is allyl chain-substituted guaiacol, a member of the allylbenzene class of chemical compounds [1][2]. While Ciprofloxacin the second ligand used is an antibiotic treat a number of bacterial infections [3]. This includes bone and joint infections, intra abdominal infections, certain type of infections diarrhea, respiratory tract infections, skin infections, typhoid fever, and urinary tract infections [4]. Finally, the third ligand used is Levofloxacin, which is important antibacterial antibiotic and some types of gastroenteritis [5]. In theoretical studies, it was noted that ligand can be effective against advanced types of viruses such as Corona virus [6]. Interested research in the field of complexes chemistry the metallic elements that contain a mixture of ligand, their clear and important role in physiological and biological processes as anti-microbiological compounds. Based on that, a large part of the coordination chemistry. The later tones contain a mixture of ligands that contain oxygen and nitrogen donor atoms with the

metallic elements in different oxidation states, in view of the great important of equipment containing a mixture of ligands, a complexes personalized by chemical, physical and spectral technique [7][8].

2. Experimental

2.1. Materials and measurement:

All Chemical reagents used were purchased from BDH and used as provided All metal(II) salts were used as chlorides, supplied by either Merck or Fluka, also ethanol, dimethyl foramide (DMF) diethyl ether.

2.2. General Preparing of the Mixed Ligands Metal Complexes:

Dissolve 0.5 mol of ciprofloxacin or Levofloxacin with 0.5 mol of eugenol in 25 ml of ethanol and add 0.5 mol KOH at PH 9-10 and add 0.5 mol of $MCl_2 \cdot XH_2O$ with reflux for 2-3 hours with stirring. The precipitation was filtered and washed with 25 ml

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of distilled water and 10 ml of ether and dried in oven at 70°.

3. Antibacterial Activities:

The new mixed complexes (1-8) were tested as antibacterial compounds against Gram negative *E. Coli* and Gram positive *Staphylococcus* and Gram negative, *E. coli* in dimethyl formamide (DMF) and sample from 1 to 200 µg/ml were used. Their antibactericidal activities were evaluated by the well-diffusion method. 1 cm³ of a day broth culture containing 106 CFU/cm³ was placed in sterile Petri-dishes. Molten nutrient agar (15 cm³) 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 a day at 37°C. [9] tables (6)

4. Results and Discussion

Tables (1-5) show the results of the conductivity data, IR spectroscopic, electronic spectra, magnetic moment data, metals %, CHNS and physical properties of complexes. On the basis of elemental analyses (Table 1) the complexes were found to have ML₁L₃.2H₂O and ML₂L₃.2H₂O, M= Fe(II), Co(II), Ni(II) and Cu(II) (L₁= Ciprofloxacin, L₂= Levofloxacin and L₃= Eugenol composition [10].

Molar conductivity measured in DMF solution of these complexes indicates that these complexes are non-electrolytes [11][12][13]. Molar conductivity values in DMF at 10⁻³ M suggest that, these complexes are non-

electrolytes and do not conduct an electric current and when dissolved in water, they do not produce ions. This means that ligands become anionic via complexation due to their losing the proton and they make with the central cationic metals the non-ionic coordinating complexes spheres. But these molar conductivity values can not be specified whether these ligands are bidentate ligands or not, and this is proved by CHN and magnetic investigations [14].

3.1. IR spectra of complexes: ciprofloxacin ligand spectrum shows three bands at 1120, 1114 and 1160 cm⁻¹ which may be assigned to three C-O groups respectively [15].

The band of C=O appeared at 1625 cm⁻¹, symmetric CO₂ and asymmetric CO₂ groups shown at 1384, 1625 cm⁻¹ respectively. Levofloxacin ligand shown C-O at 1118, 1150 and 1158 cm⁻¹, C-O at 1620 cm⁻¹ and symmetric and asymmetric CO₂ at 1395, 1630 cm⁻¹ [16][17]. And eugenol ligand shows bands for C-O at 1121, 1148 and 1170 cm⁻¹ and C=O at 1638 cm⁻¹. The IR spectroscopy is shown in table (3).

These bands of active groups for ligands are shifted to lower frequency after coordination with metal as shown in the table [18][19]. L₁= Ciprofloxacin-H, L₂= Levofloxacin-H and L₃= Eugenol-H

3.2- Electronic spectra of these complexes:

three spin allowed transitions are observed in low spin state for Fe(II) also shown three bands for Co(II), Ni(II) and Cu(II). Cu(II) complexes, (Table 4), these complexes have octahedral geometry [20][21].

Table (5), shows the magnetic moments data for complexes [22]

Table (1): Metal %, CHNS and physical properties of complexes

No.	Compound	Colour	m.p	Molecular weight	%C (practical)	%H (practical)	%N (practical)	%M (practical)
L ₁	Cipro	White	>250	330.35	61.75 (61.43)	5.45 (5.41)	12.71 (12.63)	-----
L ₂	Levo	White	>250	360.37	59.94 (59.79)	5.55 (5.44)	11.65 (11.60)	-----
L ₃	Eug	White	>250	163.2	73.53 (73.46)	7.35 (7.29)	-----	-----
1	[FeL ₁ L ₃ .2H ₂ O]	Yellow	>250	585.4	55.35 (55.41)	5.12 (5.18)	7.17 (7.20)	9.54 (9.61)
2	[CoL ₁ L ₃ .2H ₂ O]	Purple	>250	588.48	55.06 (55.12)	5.10 (5.09)	7.14 (7.15)	10.01 (10.05)
3	[NiL ₁ L ₃ .2H ₂ O]	Green	>250	588.24	55.08 (55.01)	5.10 (5.05)	7.14 (7.10)	10.0 (9.88)
4	[CuL ₁ L ₃ .2H ₂ O]	White	>250	593.1	54.63 (54.56)	5.06 (5.01)	7.08 (7.01)	10.71 (10.66)
5	[FeL ₂ L ₃ .2H ₂ O]	Yellow	>250	615.62	54.58 (54.60)	5.20 (5.19)	6.82 (6.85)	9.10 (9.13)
6	[CoL ₂ L ₃ .2H ₂ O]	Purple	>250	618.7	54.31 (54.29)	5.17 (5.18)	6.79 (6.80)	9.52 (9.55)
7	[NiL ₂ L ₃ .2H ₂ O]	Green	>250	618.46	54.33 (54.29)	5.17 (5.12)	6.79 (6.73)	9.50 (9.48)
8	[CuL ₂ L ₃ .2H ₂ O]	White	>250	623.32	53.90 (53.90)	5.13 (5.12)	6.74 (6.71)	10.20 (10.19)

Table 2: Conductivity data of the complexes

No.	Complexes	Conductivity in DMF $\Omega^{-1} \text{ cm}^2 \cdot \text{mol}^{-1}$
1	[FeL ₁ L ₃ .2H ₂ O]	10.31
2	[CoL ₁ L ₃ .2H ₂ O]	8.82
3	[NiL ₁ L ₃ .2H ₂ O]	12.34
4	[CuL ₁ L ₃ .2H ₂ O]	18.29
5	[FeL ₂ L ₃ .2H ₂ O]	11.32
6	[CoL ₂ L ₃ .2H ₂ O]	10.02
7	[NiL ₂ L ₃ .2H ₂ O]	15.35
8	[CuL ₂ L ₃ .2H ₂ O]	23.41

Table 3: IR spectra data of the ligands (L1-L3) and complexes (1-8)

No.	Ligand and complexes formula	ν C-O (cm ⁻¹)	ν C=O (cm ⁻¹)	$\nu_{\text{sym}}\text{CO}_2$ (cm ⁻¹)	$\nu_{\text{asym}}\text{CO}_2$ (cm ⁻¹)	ν M-O (cm ⁻¹)	M-OH ₂ (cm ⁻¹)
L1	Cipro	1120, 1144, 1160	1625	1384	1625	-----	-----
L2	Levo	1118, 1150, 1158	1620	1395	1630	-----	-----
L3	Eug	1121, 1148, 1170	1638	-----	-----	-----	-----
1	[FeL ₁ L ₃ .2H ₂ O]	1145, 1182, 1200	1607	1392	1568	625, 675, 680, 702	746
2	[CoL ₁ L ₃ .2H ₂ O]	1101, 1142, 1141	1601	1384	1599	624, 677, 682, 699	751
3	[NiL ₁ L ₃ .2H ₂ O]	1110, 1139, 1161	1621	1361	1610	627, 673, 679, 694	743
4	[CuL ₁ L ₃ .2H ₂ O]	1119, 1141, 1158	1619	1358	1608	624, 671, 669, 688	742
5	[FeL ₂ L ₃ .2H ₂ O]	1112, 1139, 1157	1615	1352	1603	620, 666, 671, 678	753
6	[CoL ₂ L ₃ .2H ₂ O]	1129, 1151, 1188	1581	1385	1627	555.1, 595, 613, 640	746
7	[NiL ₂ L ₃ .2H ₂ O]	1121, 1153, 1190	1578	1381	1618	612, 674, 680, 688	741

Table (4): Electronic spectra data for complexes

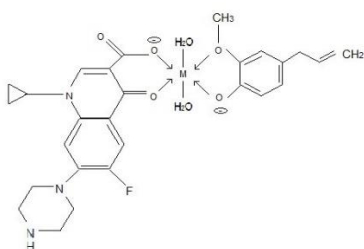
No.	Complexes	ν_1 (cm ⁻¹)	ν_2 (cm ⁻¹)	ν_3 (cm ⁻¹)
1	[FeL ₁ L ₃ .2H ₂ O]	19950.00	28735.63	39960.00
2	[CoL ₁ L ₃ .2H ₂ O]	15751.99	16666.67	23364.48
3	[NiL ₁ L ₃ .2H ₂ O]	10141.98	16805.30	24038.4
4	[CuL ₁ L ₃ .2H ₂ O]	10120.41	12500.00	23148.15
5	[FeL ₂ L ₃ .2H ₂ O]	19930.00	31446.54	39860.00
6	[CoL ₂ L ₃ .2H ₂ O]	16814.23	16781.34	24371.25
7	[NiL ₂ L ₃ .2H ₂ O]	10204.08	13227.5	28901.7
8	[CuL ₂ L ₃ .2H ₂ O]	11764.70	14705.00	23148.14

(Table 5) Magnetic measurements

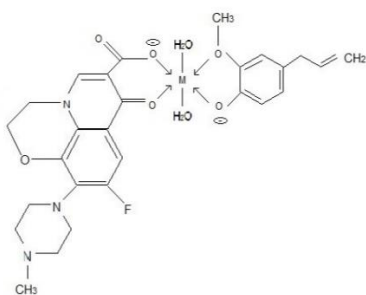
No.	Complexes	μ_{eff} (theoretical)	μ_{eff} (practical)
1	[FeL ₁ L ₃ .2H ₂ O]	0.0	0.0
2	[CoL ₁ L ₃ .2H ₂ O]	1.73	1.75
3	[NiL ₁ L ₃ .2H ₂ O]	2.84	2.86
4	[CuL ₁ L ₃ .2H ₂ O]	3.82	3.80
5	[FeL ₂ L ₃ .2H ₂ O]	0.0	0.0
6	[CoL ₂ L ₃ .2H ₂ O]	1.74	1.76
7	[NiL ₂ L ₃ .2H ₂ O]	2.83	2.85
8	[CuL ₂ L ₃ .2H ₂ O]	3.76	3.78

Table (6): The inhibition diameter (millimetre) of the bacteria after one day incubation paid and 37°C

Complex no.	E.coli	Staphylococcus
Control DMF	5	5
1	25	23
2	26	25
3	22	25
4	22	22
5	23	21
6	24	20
7	22	22
8	22	21

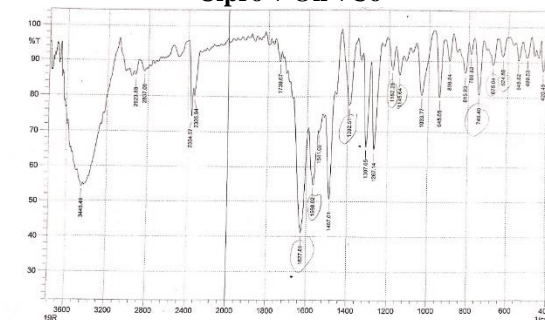


Scheme (1): The chemical structure of complexes (1-4) [M L₁L₂.2H₂O], M= Fe (II), CO (II), Ni (II) and Cu (II)



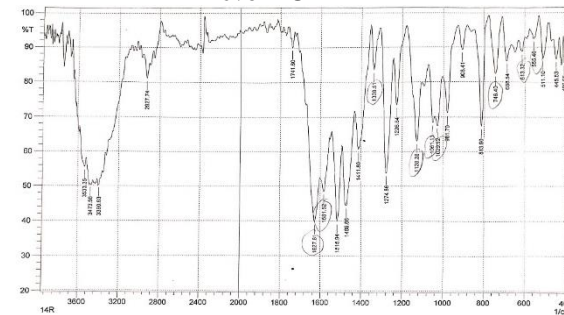
Scheme (2): The chemical structure of complexes (5-8) [M L₂L₃.2H₂O], M= Fe (II), CO (II), Ni (II) and Cu (II)

Cipro + Oil + Co



Comment: 19R 11C No. of Scans: 1619 Date/Time: 14/03/2008 02:25:28.1
Resolution: Laser: ASD

Levo + Oil + Zn



Comment: 14R 6E No. of Scans: 1419 Date/Time: 14/03/2008 06:14:18.1
Resolution: User: ASD

4. Conclusion:

These eight new complexes (1-8) of the mixed ligands have been found to act as bidentate chelating agents, and coordinate through the two oxygen atoms of Eugenol hydroxyl and ether groups with the oxygen atoms of carboxylic group and exocyclic ketone group of Ciprofloxacin or its analogous Levofloxacin. These mixed ligands complexes contain five and six membered chelate rings, which have almost no strain. The molar conductance data for the metal complexes show non-electrolytic behavior in DMF solvent.

The all synthesized complexes which show non-electrolytic properties, also they were no conducting electrical current behaved as bi-dentate with octahedral geometrical isomers. Antimicrobial showing that all mixed complexes were less activity against Staphylococcus and E. Coli aureus, Escherichia coli, and Bacillus than Pseudomonas

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تحضير معقدات جديدة من Fe(II), Co(II), Ni(II) and Cu(II) مع خليط من ليكندات السيبروفلوكسازين او الليفوفلوكسازين مع اليوجينول ودراسة صفاتها الكيمياوية والفيزياوية

الملخص:

حضرت ثمان معقدات لخلائط ليكندية جديدة من Fe(II), Co(II), Ni(II) and Cu(II) وينسب مولية (1:1:1) من السيبروفلوكسازين-اليوجينول او الليفوفلوكسازين-اليوجينول في وسط قاعدي. كانت توقعات التناسق بين خليط الليكندات تجاه ايونات الفلزات وعلى ضوء تحليل العناصر والتوصيلية المولارية وطيف الاشعة تحت الحمراء والفوق بنفسجية وقياسات المغناطيسية بانها ثنائية السن غير الكتروليتية. توقعت بيانات القياسات الكهربائية والمغناطيسية بان اشكال المعقدات الجديدة كافة هي هرم ثمان السطوح.