Global Journal of Science Frontier Research: B
Chemistry
Volume 14 Issue 2 Version 1.0 Year 2014
Type : Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4626 & Print ISSN: 0975-5896

Synthesis, Characterization, Antibacterial, and Extraction Studies of Dioxouranium (Uo22+) Ofn, N'-[(4, 4'-Biphenyl Bis (Methylidene))] Di Nicotinic Hydrazine

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Abstract- New Hydrazonic Schiff base was synthesized by reaction Nicotinic hydrazidewith Biphenyl-4,4'-Dicarbal-dehydehave been characterized by elemental analyses IR, massand1H-NMR spectral data Hydrazoic Schiff base have been studied by liquid-liquid extraction towards the metal ion Uo(II) from aqueous phase to organic phase. behave as a good extractant ligand for uranyl ions Uo(II) from aqueous solution, and the study of conditions of extraction shows that the optimum pH values for extraction was (pH= 5.2), so the suitable concentration of Uo(II) ions in aqueous solution which is giving highest distribution ratio (D) was (1x10-4M), in addition the optimum shaking time to reach the equilibria was (60 min.), as well as the stoichiometric study by using three methods shows the structure of Uo(II) ions complex with ligand was 1 : 1 (metal : ligand), in addition the study of organic solvent effect appear there is no straight line relation between the distribution ratio for extraction of Uo(II) ions and dielectric constant for organic solvents but this study demonstrate there is an effect for the structure of organic solvent used, thermodynamic study shows the complexation reaction an endothermic.The new Schiff Bases was studied for antibacterial activities against (Bacillus subtilis and Staphylococcus aureus) are Gram positive and (Salmonella typhi and Escherichia coli) are Gram negative. The compound ligand was exhibited a variable activity of inhibition on the growth of the bacteria.

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GJSFR-B Classification : *FOR Code: 250399, 030599*

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I. Introduction

Schiff bases are widely studied and used in the fields of organic synthesis and metal ion complexation [1, 2] for a number of reasons: their physiological and pharmacological activities [3-5] their use in ion selective electrodes [6-11] in the determination of heavy metals ions in environmental samples [12] and in the extraction of metals ions [13,14] and their many catalytic applications (e.g. for epoxidation of olefins, alkene cyclopropanation [15,16] trimethylsily-lcyanation of ketones [17] asymmetric oxidation of methyl phenyl sulfide enantioselective-epoxidation of silylenol [18] and ring- opening Polymerization of lactide [19]. Hydrazones are special group of compounds in the Schiff bases family. They are characterized by the presence of (C=N-N=C). the presence of two inter-linked nitrogen atoms was separated from imines, oximes, etc. hydrazone Schiff bases of acyl, aroyl and heteroacroylcompounds have additional donor sites like C=O. The additional donor sites make them more flexible and versatile. This versatility has made hydrazones good polydentate chelating agents that can form a variety of complexes with various transition and inner transition metals and have attracted the attention of many researchers. Various hydrazones are obtained depending on the experimental conditions; which have application as biologically active compounds [20] and as analytical reagents [21]. As biologically active compounds, hydrazones find applications in the treatment of diseases such asanti-tumor [22] tuberculosis [22] leprosy and mental disorder [23]. Tuberculostatic activity is attributed to the formation of stable chelates with transition metals present in the cell. Thus many vital enzymatic reactions catalyzed by these transition metals cannot take place in the presence of hydrazones [24,25]. Hydrazones also act as herbicides, insecticides, nematocides, rodenticides and plant growth regulators.

Uranium exists in various concentrations in all parts of the environment, in certain types of rocks*e.g*. Some types of granites, and various mineral deposits. There are also some artificial contributions of uranium to the environment *e.g*. from mineral exploration, emissions from the nuclear industry, the combustion of coal and other fuels, and the use of phosphate fertilizers that contain uranium.[26].1 Natural uranium is one of the elements that can be transferred to the plants or accumulated under the influence of microbial processes including oxidoreduction, production of complexing compounds, and biosorption. In this way, plants and fungi are directly involved in the absorption, accumulation of major and trace elements including radionuclides. In natural and also in disturbed environments, accumulation of uranium has been observed in plants, mushrooms and fungal mycelium. [27] The contents have been observed in mycelia by

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coupling the microscopic and spectrometric methods. The complex compounds formed between uranyl ions and different complexing agents are of great interest due to their possibilities to be applied in extraction of metallic ions from ores, extraction of uranium from solutions of low concentration treatment of the radioactive waters and in environmental chemistry. It is known the fact that the uranylions have a big complexing capacity in the presence of different organic and inorganic compounds. Behavior of uranium in solution is very interesting. Usually, uranium is found in form of uranyl ions very stable in both solution and solid state. From the structural point of view, the uranyl ions has in its center the uranium atom with the oxidation state (VI), and the two atoms of oxygen form two double bonds O=U=O with an angle of 180° between them (linear, stable structure), fact demonstrated by Duval [28] and Frankuchen [29] (in his studies over the uranyl and sodium acetate). The ligands coordinate equatorially to the uranium atom and in a perpendicular plane on the plane of the O=U=O bonds, coordination numbers being between 4 and 7 depending on the chemical surrounding.[30-32] The Schiff bases are chelating agents used to get different complexes with transitional metals. They form complexes compounds with different metallic ions in the 1/1 ratio form 3 very stable chelate cycles. Taking into account the high capacity of the Schiff bases to coordinate metallic ions, these are the intensively utilized as complexing agents to extract some. Metals from various media. The uranyl ions form complex compounds with numerous Schiff bases showing a strong affinity for ligands with oxygen and nitrogen-bearing ligands, a series of such complexes being already studied. [33-36].

II. Experimental

a) *Reagents and Apparatus*

All the chemicals used were of AnalaR grade and procured from Sigma-Aldrich and Fluka. Metal salts were purchased from E. Merck and were used as received. Distilled water was used in the extraction experiments. The solvents were saturated with each other before use in order to prevent volume changes of the phases during extraction. The C, H, and N were analyzed on a Carlo-Erba 1106 elemental analyzer. The IR spectrum was recorded on Jusco 300 instrument in KBr pellets. ^{1}-H NMR spectra of ligands in CDCl3 solution were recorded on a Bruker DT-400 MHz spectrometer, and chemical shifts are indicated in ppm relative to tetra methyl silane. Mass spectra were recorded using a KRATOS MS50TC spectrometer.

AA 929 Unicam Spectrometer was used for FAAS measurements with an air-acetylene flame. A pH meter (Metrohm–691pH Meter) was also used. All extraction experiments were performed by using a mechanical flask agitator in 50 cm^3 stoppered glass flasks, M.P Apparatus Digital (32-300 ^{0}C).The thermo gravimetric analysis (TGA) was carried out in a dynamic nitrogen atmosphere (20 mL.min$-^1$), with a heating rate of 10 ◦C min−1 using Shimadzu TGA-50H thermal analyzers.

c) *Synthesis of N,N'-[(4,4'-biphenyl bis (methylidene))] di nicotinic hydrazide*

The hot ethanolic solution (30mL), of 4, 4'-biphenyl aldehyde (1 mmol, 0.210 g), and a hot ethanolic solution (30mL), of nicotinic hydrazide (2mmol, 0.274 g), were mixed slowly with constant stirring. Containing a few drops of concentrated HCl. The reaction mixture was heated to reflux for 4hrs, where white precipitate was formed scheme (1). The solid obtained was collected and recrystallized from mixture DMF, EtOH (9: 1) as white crystals. A yellow colored precipitate was washed with water, ethanol, $CHCl_3$ and diethyl ether, respectively, and dried under vacuum over P2O5.

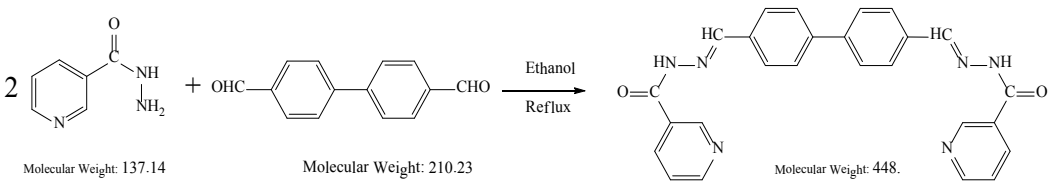
White; Yield: (80 %), m. p= 285 ^{0}C, Empirical formula ($C_{26}H_{20}N_6O_2$), M. Wt: (448 g)

Mass spectrum (m/z): 448. (Figure 1).

UV-Vis: λmax = 360 nm. . (Figure 4).

IR (KBr disk): 3248.13 cm^{-1} (N-H), 3062.96 cm^{-1}(C-H), aromatic, 1651.07 cm^{-1} (C=O), 1600.92 cm^{-1} (C=N). (Figure 2).

^{1}H-NMR ($CDCl_3$-400MHz) δ =12.0957(s, 2H, CO-NH-), 9.093 (s, 2H, CH=N), 7.591 - 8.979 (m,16H, Ar), 2.508 -2.677(DMSO,H_2O). (Figure 3).



Scheme (1) (I)

b) *Procedure of Extraction*

The extraction properties of the Schiff base ligand (I) was investigated under liquid–liquid phase and neutral condition using transition metal picrates Uo (II) as substrates and measuring by UV–vis measurements the amounts of metal picrate in the aqueous phase before and after treatment with the compounds. About 10 mm of 2×10^{-5} M aqueous picrate solution and 10

mm of 1×10^{-3} M solution of ligand in $CHCl_3$, CH_2Cl_2, C_6H_6 were vigorously agitated in a stoppered plastic tube with a mechanical shaker for 2 min, then magnetically stirred in a thermo stated water bath at 25 ^{0}C for 1 h, and finally left standing for an additional 30 min. The concentration of the picrate ion remaining in the aqueous phase was then determined spectrophotometrically. Blank experiments showed that no picrate extraction occurred in the absence of ligand. Transition metal picrate were prepared by successive addition of 1×10^{-2} M metal nitrate solution to 2×10^{-5}M aqueous picric acid solution and shaken at 25 ^{0}C for 1 h.This metal picrate Uo(II) was measured by UV–vis using maximum wavelength 352 nm. For each combination of host and metal picrate, the picrate extraction was conducted on three different samples and the average value of percent picrate extracted, with a standard deviation, was calculated. In the absence of host, a blank experiment, no metal ion picrate extraction was detected. The extractability was calculated by using the equation below:

$$\text{Extractability (\%)} = \left(\frac{A_0 - A}{A_0}\right) \times 100$$

Where A_0 is the absorbance in the absence of ligand. A denotes the absorbance in the aqueous phase after extraction. [37].

d) Biological Activity

The prepared compounds were tested for their antimicrobial activity against four speices of bacteria (Bacillus subtilis, Escherichia coli , Staphylococcus aureus, Salmonella typhi) using filter paper disc method [38]The screened compounds were dissolved individually in DMSO (dimethyl sulfoxide) in order to make up a solution of 50, 100, and 200 µg/ml concentration for each of these compounds. Filter paper discs (Whitman No.1 filter paper, 5mm diameter) were saturated with the solution of these compounds. The discs were placed on the surface of solidified Nutrient agar dishes seeded by the tested bacteria. The diameters of inhibition zones (mm) were measured at the end of an incubation period, which was 24 h at 37C for bacteria. Discs saturated with DMSO are used as solvent control. Ciprofloxacin 100 µg/ml was used as reference substance for bacteria**. [38].**

III. Result and Discussion

a) Synthesis

The prepared organic compound (I) was synthesized by the condensation of4,4'-biphenyl aldehyde with nicotinic hydrazide in the molar ratio 1:2 in absolute ethanol . The reaction proceeded smoothly, producing the corresponding Schiff bases in good yield. The ligand is soluble in common organic solvent but insoluble in water. The structures of the ligand was elucidated by elemental analyses, MS, FTIR, electronic absorption, and ^{1}H- NMR spectra, which help in elucidating their empirical formula (Table 3.1).

b) Elemental analyses of Schiff base

The results of elemental analyses Schiff base, as shown in Table (3.2), are in good agreement with those required by the proposed formulae

Table 3.1 : Color, molecular weight and melting point of Schiff base (I)

Schiff base	Color	M. Wt	Melting point ^{0}C	λ_{max} nm	Yield %	Crystallization Solvent
I	White	448	285	360	80	DMF , EtOH

Table 3.2 : Elemental analysis data of Schiff base (I)

Schiff base	Elemental analysis Calculated (Found %)				
	C	H	N	S	O
I	69.34 (69.63)	4.56 (4.49)	19.11 (18.74)	--------	6.99 (7.14)

c) IR Spectra

The IR Spectraldata are shown in table (3.3) of the prepared Schiff base. The band at 1600.92 cm^{-1}is attributed to imine group (-HC=N-) for (I) (Fig 2). The band in the spectra at 1579.8 - 1420.4cm^{-1}is due to (C=C) of aromatic rings. while the band at 2858.5-2933.5cm^{-1} are attributed to (C-H alkanes) for (I) .Also, the band at 3062.96cm^{-1} are attributed to (C-H ar) .While the band at 3248.13cm^{-1} are attributed to (N-H), and the band at 1651.07cm^{-1} are attributed to (C=O). However, in the IR spectra of Schiff bases this band (C=O) disappears and a new vibration band for azo methane (-HC=N-) is observed at 1600.92 cm^{-1}, indicating that complete condensation takes place. . [39-40].

Table 3.3 : IR spectral data (cm^{-1}) of Schiff base (I)

Schiff base	v(C=C)	v(HC=N)	v(C=O)	v(C-H) aliph	v(C-H) arom	v(N-H)
I	1579.8 - 1420.4	1600.92	1651.07	2858.5-2933.5	3062.96	3248.13

d) ^{1}-H-NMR Spectra of Schiff base (I)

The data of ^{1}-H-NMR Spectra of prepared Schiff base is shown in table (3.4). The ^{1}-HNMR spectra of (I) ligand in d6-DMSO (Fig 3) shows a singlet signal at 9.093ppm assigned to the protons (HC=N-) groups of the ligand, while the singlet signal at 12.0957 ppm assigned to the protons (CO-NH) group of the ligand (I). The multiple signals 8.979 - 7.591 ppm are due to the aromatic protons. The other obtained values for ^{1}-H-NMR chemical shifts of the compound is given in the experimental section.

The ^{1}-HNMR spectral data of the new compound. These data are in good agreement with those previously reported for similar compound. These results strongly suggest that the proposed compound has been formed. **[39-40].**

Table 3.4 : ^{1}-H-NMR Spectra of Schiff bases (I)

Schiff base	Chemical Shifts δ ppm		
	C-H aromatic	CH=N	-CO-NH-
I	8.979 - 7.591 (m,16H)	9.093 (s,2H)	12.0957 (s,2H)

IV. Results and Discussion

The complexation reaction between the ligand (I) and Uo(II) ion to produce the ion pair complex have to extracted to the organic phase, this complexation reaction of necessity behave among many optimum condition to reach equilibria and giving stable ionpair complex .

a) Effect of pH

Extracted of 10 ml of Uo(II) ion in aqueous phase at different pH (3 –12) by using (10 ml) of (1×10^{-4} M) ligands dissolved in chloroform, after that shaking the two layers for suitable time and separate this two layers and determined the remainder of Uo (II) ion in aqueous phase and Uo (II) ion transfer to the organic phase as complex by stripping method or by difference method according to general procedure, afterward determine the distribution ratio (D) and percentage of extraction (E_{ex}%) at each pH, the results in Table (3.5), and Fig. (5) Shows the optimum of pH extraction was (pH_{ex} = 5.2). At pH less than optimum value effect to protonated ligand to occupy the pair of electron and then can't coordinate strongly with Uo (II) ion and give less stable ion pair complex and minimize the distribution ratio (D) and percentage of extraction (E_{ex}%), also atpH values more than optimum value effect to decrease distribution ratio (D) and percentage ofextraction (E_{ex}%) by reason of formation ion pair complex contain anion (OH) this complex more soluble in aqueous phase and less extracted to organic phase and sovereignty the dissociation equilibria.

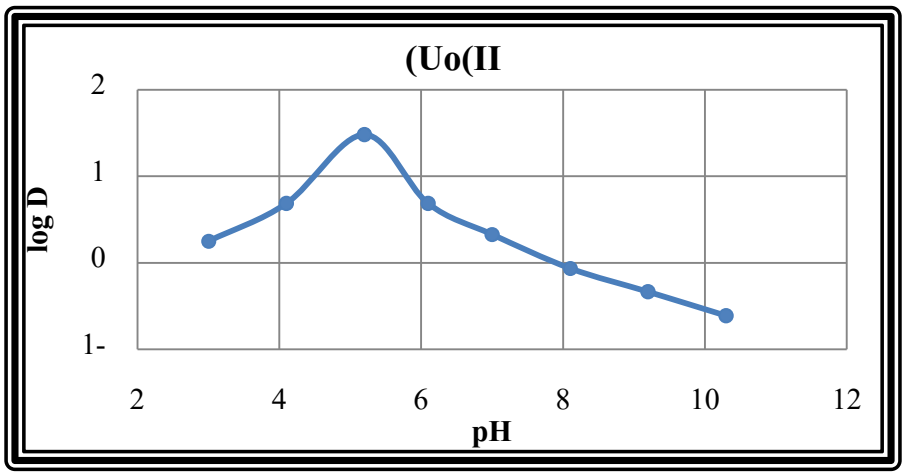


Figure 5 : pH effect on the extraction of Uo (II) ion

Table 3.5 : Effect of pH on the extraction of Uo (II) ion

pH	UO(II)		
	log D	D	E%
3	0.252	1.786	64.1
4.1	0.686	4.848	82.9
5.2	1.481	30.25	96.8
6.1	0.686	4.848	78.9
7	0.329	2.135	62.1
8.1	-0.063	0.866	46.4
9.2	-0.335	0.462	31.6
10.3	-0.613	0.244	19.6
11.1	0	0	0

b) Effect of Shaking Time

Extraction of Uo (II) ion from (10 ml) aqueous phase at (pH =5.2) by using (10 ml) of organic phase of (1×10^{-4} M) ligand dissolved in chloroform, after shaking the two phases at different times, separate the two phases and determine the concentration of Uo (II) ion remainder in aqueous phase and the concentration of Uo(II) ion transfer to organic phase as ion pair complex by previous spectrophotometric method and then determine distribution ratio (D) and percentage of extraction (E_{ex}%). The results in Table (3.6) and Fig. (6) demonstrate that the optimum shaking time was (60 min.) to reach the equlibria of complexation reaction and giving higher distribution ratio (D), the shaking time less than optimum shaking time not allow to reach for equilibria and giving low distribution ratio (D), but at shaking time more than optimum time effect to favor the dissociation step on the complexation and minimize the distribution ratio (D) depend on the kinetic energy of reaction.

Table 3.6 : Effect of shaking time on extraction of Uo (II)ion

Shaking Time	UO^{+2}		
	Log D	D	E%
10	0.037	1.088	52.11
20	0.197	1.573	61.14
30	0.417	2.613	72.32
40	0.712	5.15	84.64
50	0.878	7.547	88.29
60	1.318	20.79	95.41
70	0.999	9.99	90.90
80	0.777	5.99	85.69
90	0.535	3.429	77.42
100	0.343	2.205	68.92
110	0.085	1.217	54.89
120	0.029	1.070	51.69

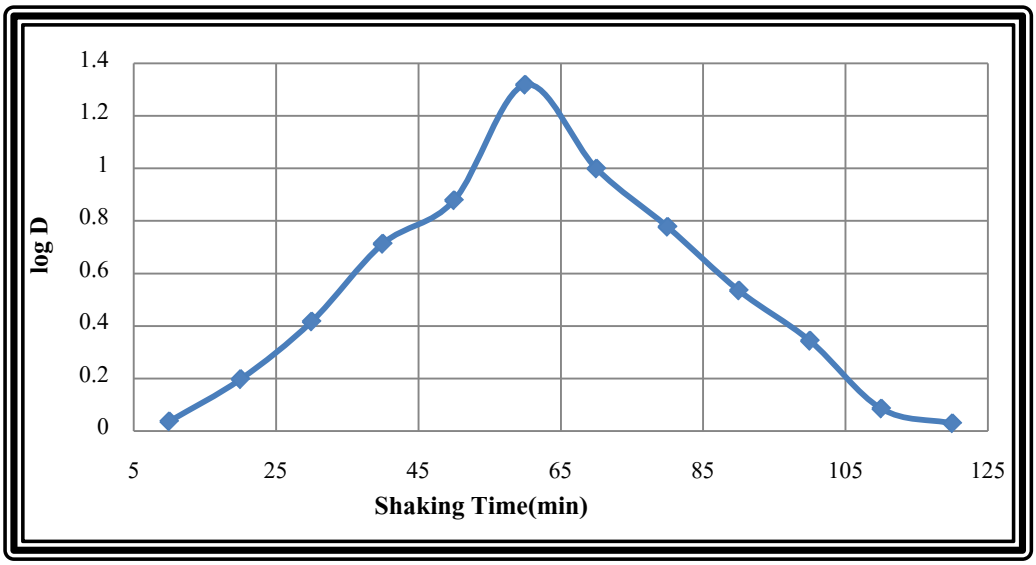


Figure 6 : Effect of shaking time on the extraction of Uo (II) ion

c) Stoichiometry by Slope Analysis Method

To knowing the more probable structure of Uo (II) ion pair complex produced, extracted (1×10^{-4} M) Uo (II) ion from (10 ml) aqueous phase at (pH= 5.2) by using (10 ml) of ligand solution dissolved in chloroform at different concentration (2 $x10^{-5}$M –3×10^{-4} M), after shaking the two layer for (60 min.), separate these layers and determine the remainder quantity of Uo (II) ion in aqueous phase and transfer quantity of Uo (II) ion to organic phase as complex, after that determine distribution ratio (D) and percentage of extraction (E_{ex}%) by previous method (spectrophotometric method). Afterward plot log D against log [Ligand]. The results in Table (3.7) and Fig. (7) shows from the slope of straight line that the more probable structure of ion pair complex extracted was 1: 1(metal : ligand).

Table 3.7 : Slope analysis method for extraction of Uo (II) ion

Log [L]	Uo(II)		
	D	E%	slope
-4.698	0.639	38.98	1.352
-4.522	1.387	58.11	
-4.397	1.932	65.89	
-4.301	2.911	74.43	
-4.097	6.109	85.93	
-4	18.58	94.89	
-3.698	18.03	94.75	
-3.522	17.87	94.70	

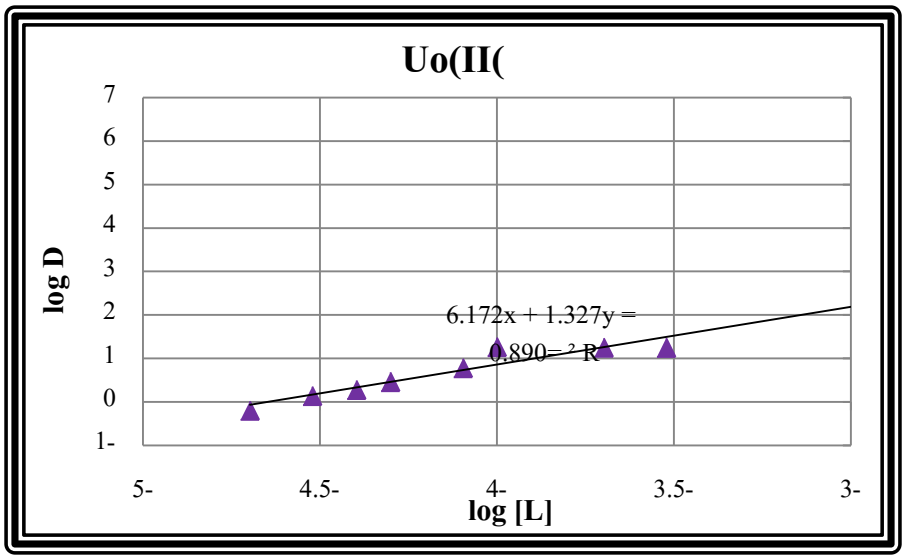


Figure 7 : Slope analysis method for extraction of Uo (II) ion

d) Organic Solvent Effect

Solvent extraction method take care of orgain extraction method; according to this concept extracted (1×10^{-4} M) Uo (II) ion in (10 ml) aqueous phase at (pH= 5.2) by (10 ml) organic phase contain ligand dissolved in different organic solvents at concentration of (1×10^{-4}M), after shaking for (60 min) separate the two layers and determine the remainder Uo (II)ion in aqueous phase and Uo (II) ion transfer to organic phase as Uo (II) complex, according to previous method, afterward calculate the distribution ratio (D) and percentage of extraction (E_{ex}%). The results in Table (3.8) shows there is not any linear relation between distribution ratio (D) and dielectric for organic solvents used in extraction method of Uo (II) ion, Fig(8) as well as this results reflect the effect of organic solvent structure on the extraction method and without any effect for polarity of organic solvent, and reflect the effect on ion pair complex extracted to be contact ion pair (tight ion pair) or solvennic solvent used t separated ion pair (loose ion pair).

Table 3.8 : Organic solvents effect on the extraction of Uo (II) ion

Solvents	ε	Uo(II)	
		D	E %
Dichloro methane	9.08	5.211	83.9
Chloroform	5.708	22.81	95.8
Benzene	2.804	1.770	63.9

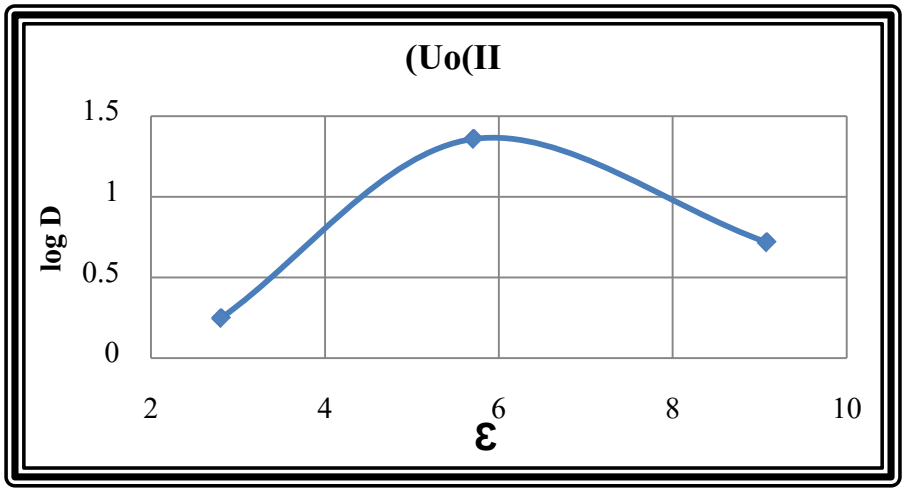


Figure 8 : Effect of solvents organic on the extraction of Uo (II) ion

e) Effect of Temperature

Extraction of Uo(II) ion in (10 ml) aqueous phase at (pH = 5.2) by using (10 ml) of (1×10^{-4} M) ligand dissolved in chloroform at different temperature (10 – 40°C), after shaking the two layers for optimum time and separate the two layers, determine distribution ratio (D) according to the general procedure. The results in Table (3.9) and Fig. (9) illustrate the complexation reaction between ligand and Uo(II) ion was Endothermic reaction, that is mean the coordination association between ligand and Uo (II) ion increase with temperature increasing.

Table 3.9 : Temperature effect on the extraction of Uo (II) ion

T.C^0	T.K^0	1/Tx10^{-3} K^0	Uo(II)		
			Log D	D	E %
10	283	283	0.389	2.45	71.02
20	293	293	0.905	8.04	88.93
30	303	303	1.391	24.6	96.09
40	313	313	2.093	124	99.2

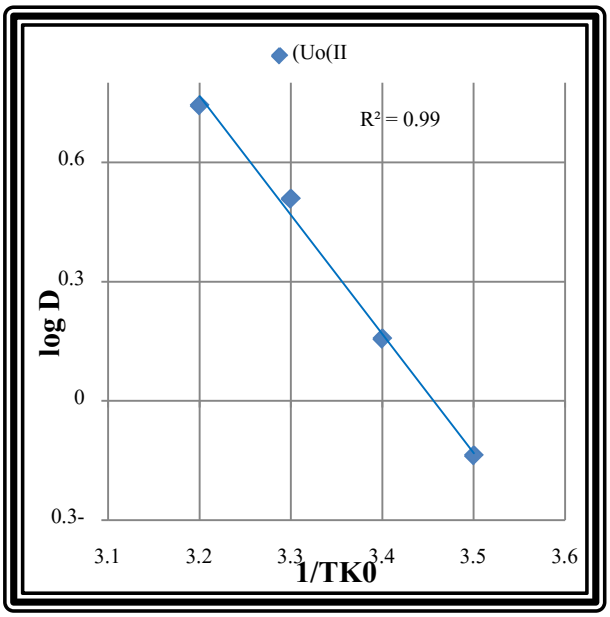


Figure 9 : Temperature effect on the extraction of Uo (II) ion

After calculated the thermodynamic data for extraction method to Uo (II) ion by using the below relation:

Using the below relation:

$$K_{ex} = \frac{D}{[M^{n+}]_{aq}[L]_{org}} \qquad (4.1)$$

Plot log K_{ex} against 1/T °K and determine the slope of the straight line relation, calculate ΔH_{ex} as in the relation:

$$\frac{\Delta \log K_{ex}}{\frac{\Delta 1}{T}} = \frac{-\Delta H}{2.303\ R} \quad (4.2)$$

$$\text{Slope} = \frac{-\Delta H}{2.303\ R} \qquad (4.3)$$

$$\Delta G_{ext} = -RT\ \ln K_{ext} \qquad (4.4)$$

$$(4.5)\Delta G_{ext} = \Delta H_{ext} - T\Delta S_{ext}$$

After application of these relation, found the value of enthalpy for extraction of Uo(II) ion was (ΔH_{ex} = 108.76 kJmol^{-1}) and Gibbs free energy was (ΔG_{ex} = -61.06kJmol^{-1}), as well as the entropy was (ΔS_{ex} = 542.56J mol-1) these results shows from the value of ΔH_{ex} the ion pair complex structure was 1 : 1 which is giving low value for ΔH_{ex}, but the high value for ΔS_{ex} reflect that complexation reaction was entropic in region [39]from other hand the endothermic reaction shows good association between Uo (II) ion and ligand and may be produce contact ion pair (Tight ion pair).

Table 3.10 : Thermodynamic parameters of Ligand from extraction of Uo (II)ion

Cation	K_{ext}	ΔS_{ext} jK^{-1}mol^{-1}	ΔG_{ext} kjmol^{-1}	ΔH_{ext} kjmol^{-1}
Uo(II)	15.5 x 10^9	542.56	-61.06	108.76

V. Biological Activity

During the last two or three decades, attention has been increasingly paid to the synthesis of Schiff bases which exhibits various biological activities including antibacterial, fungicidal, tuberculostatic and plant growth regulative properties **[41]**. It was judicious to investigate the synthesis of various new types of Schiff base and studied their antibacterial activity against four strains of bacteria (Bacillus subtilis, Escherichia coli, Staphylococcus aureus, Salmonella typhi). The concentrations used for the screened compounds are 50, 100, and 200 µg/ml. Ciprofloxacin was used as reference standard while DMSO as control

and inhibition zones are measured in mm. The new compounds were tested against one strain each of a gram positive and two gram negative. The test results presence in Table (3.11), a new compound was active against tested and another compounds are no active.

All compounds are no active where used 50, 100 µg/ml but active in the concentrations 200 µg/ml see table (3.4).

Table 3.11 : Effect of new azo Schiff bases on the growth of tested bacteria (conc.200 µg/ml)

Shiff base	Bacteria			
	Gram negative		Gram positive	
	B. subtilis	S. aureus	E.coli	S. typhi
I	20 mm	18 mm	17 mm	19 mm
Control	00 mm	00 mm	00 mm	00 mm
Ciprofloxacin	20 mm	20 mm	20 mm	20 mm

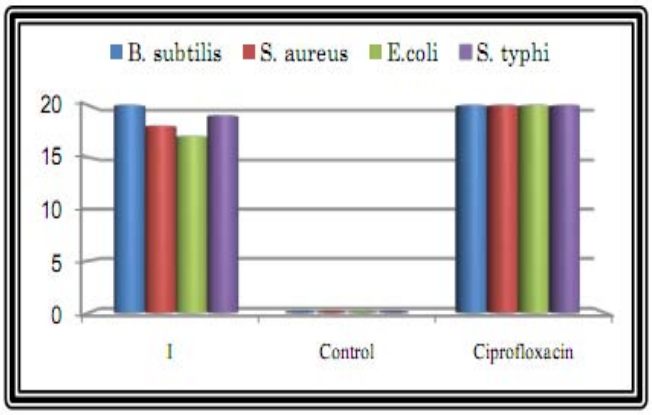


Figure 9 : Antibacterial activity (Gram positive, negative) of synthesized compounds

VI. Conclusion

1. The (I) compound is new and was prepared for the first time.
2. The new compound was identified by 1HNMR, IR, LC-MS spectral methods.
3. The compound showed a high draw ratio of copper ion at pH = 5.2 and the best organic stores is chloroform and that there is no linear relationship between the polarity of the shops and the distribution ratio (D).
4. That shaking a time more than a time best, which represents the time required to complete the process complexity and give a complex stable lead to lower values ratios distribution D and this would lead to the possibility of a reflection of interaction and increase the speed of interaction back and eventually dismantle the complex and perhaps a few Side reactions that may lead to the occurrence of the phenomenon of the three layers (Three layers) for the analysis of solutions and this is what requires us to comply with a time of shaking out the best.
5. That the rate of ion correlation between copper and composite studied by Molar (cation: connected (1:1) between the ligand and the cation.
6. Calculated some parameters associated with extraction, such as constant extraction as well as parameters thermodynamic namely, enthalpy change(ΔH*),entropy change (ΔS*), and Gibbs free energy change (ΔG*).
7. proven data study the effect of different temperatures on the recovery operations that the formation of complexes between ligand and cation studied endothermic (Endothermic) , as indicated negative values of energy free to spontaneous reactions, as also indicated positive values of entropy system that many random.
8. The prepared compound has been biologically screened i.e. studying their effects against two gram-positive, two gram-negative bacteria. The results show that their activities were found to vary from moderate to very strong.

VII. Acknowledgment

The authors are grateful to the Department of Chemistry, Faculty of Science, University of Damascus, Damascus, Syria for supporting of this paper.

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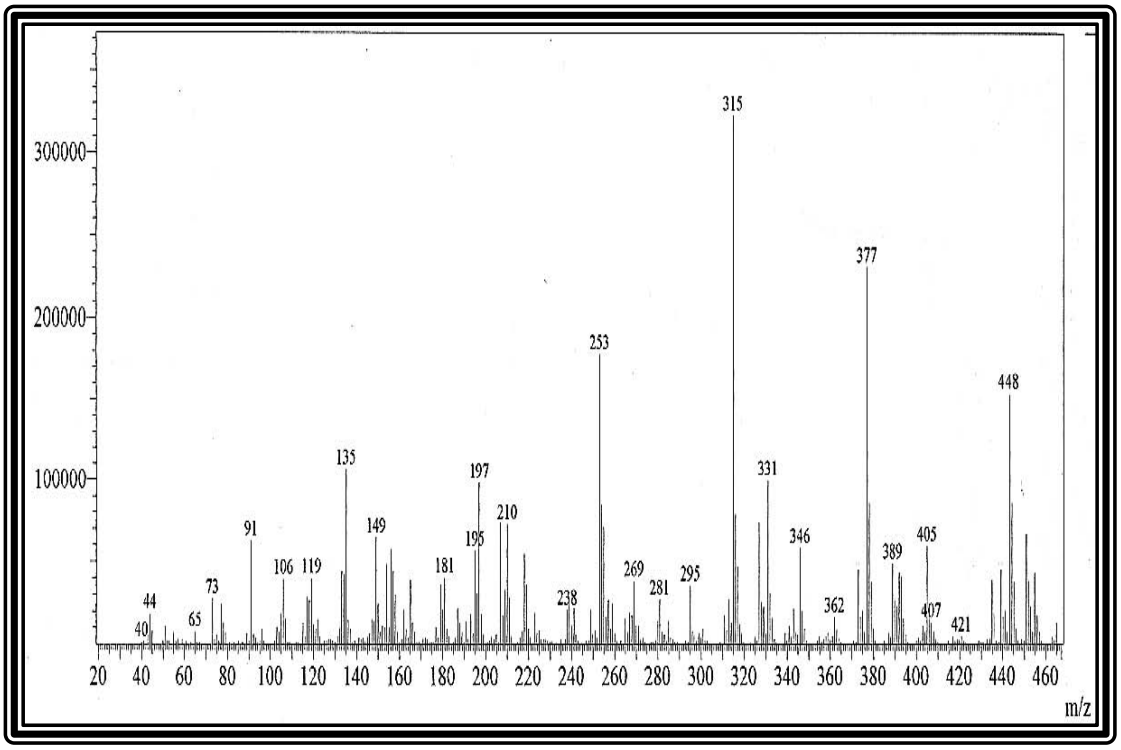

Figure 1 : MS spectra of ligand (I)

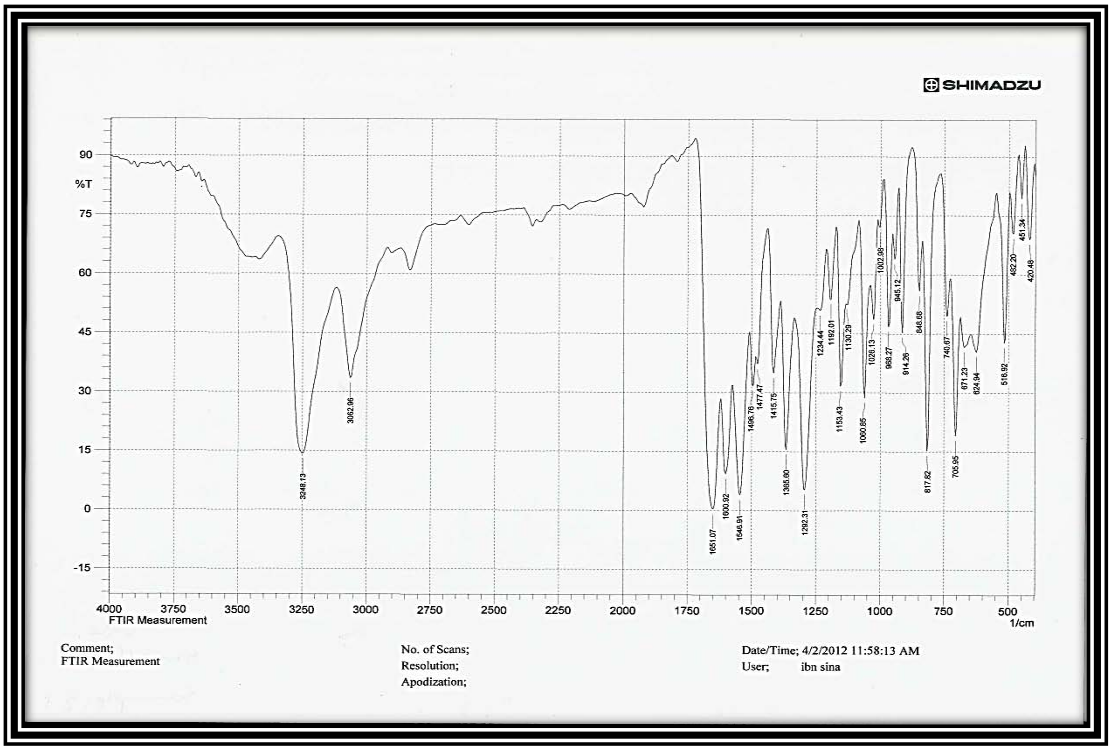

Figure 2 : IR spectra of ligand (I)

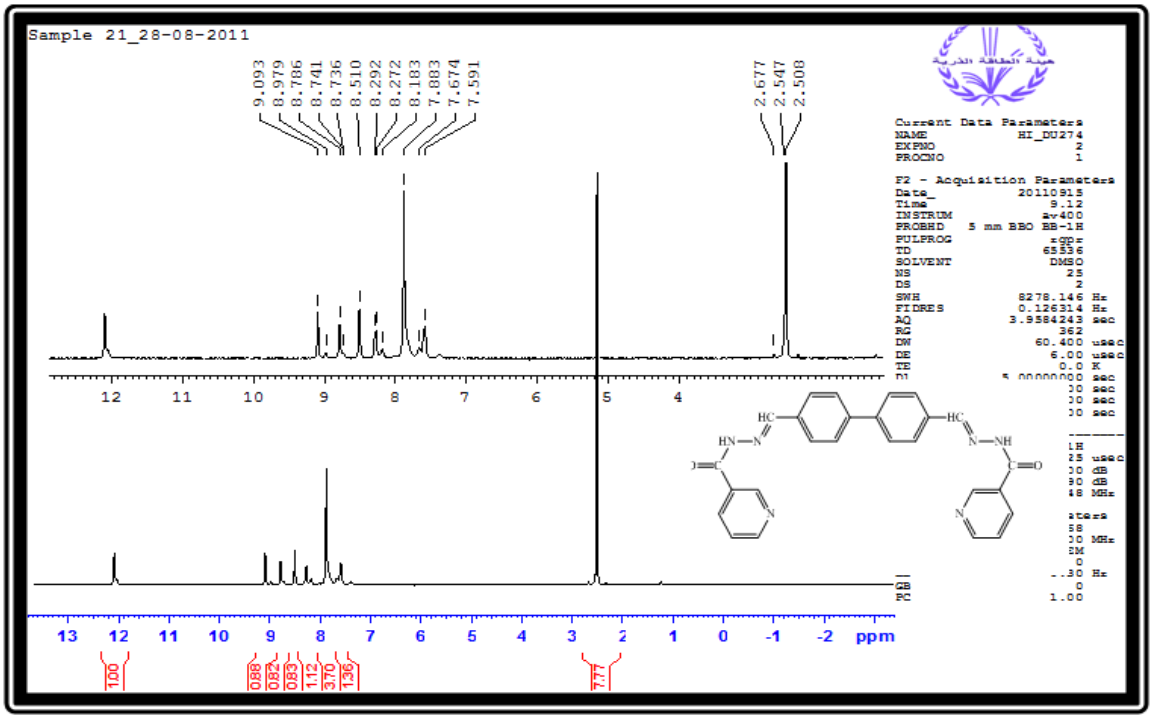

Figure 3 : ^{1}H-NMR spectra of ligand (I)