



SYNTHESIS, CHARACTERISATION AND BIOLOGICAL STUDIES ON Cu (II) and Mn (II) QUINOLINE SCHIFF BASE COMPLEXES

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ABSTRACT

Schiff bases play an important role in inorganic chemistry as they easily form stable complexes with most transition metal ions. The preparation and study of inorganic compounds containing biologically important ligands **Nora H. Al-Shaalan (2011)**. The fact that copper, magnesium, iron, zinc and manganese are important metallic elements and display great biological activity when associated with certain metal-protein complexes, participating in oxygen transport, electronic transfer reactions, has produced enormous curiosity in the study of systems containing these metals.^[10-11] Molecules containing donor-acceptors such as Schiff bases have ability to serve as polymeric ultraviolet stabilizers, laser dyes. The present work is focused on the study of co-ordination behaviour of thiosemicarbazone Schiffbase with hydrated Cu(II) and Mn(II) chlorides. Analytical and spectral data confirmed the structure of the complexes. Also absorption at 305nm might be due to the extended conjugation of the ring or may be due to the ring residue. Antibacterial and Antifungal activities were carried out using Disc diffusion method and the compounds were found to be active. A number of metal coordination complexes of Schiff bases have been suggested as antibacterial, antifungal, cytotoxic, anti-inflammatory and Cytostatic agents.^[12-14]

KEYWORDS: Schiff base complexes, Antibacterial activity, Antifungal activity.

INTRODUCTION

Coordination compounds have found application in medicine in the treatment and diagnosis of diseases **Fenton (1995)**. Coordination compound, any of a class of substances with chemical structures in which a central metal atom is surrounded by nonmetal atoms or groups of atoms, called ligands, joined to it by chemical bonds. Many enzymes, the naturally occurring catalysts that regulate biological processes, are metal complexes. a hydrolytic enzyme important in digestion, contains a zinc ion coordinated to several amino acid residues of the protein. **J. Anastassopoulou (1995)**. *The synthesis and characterization of transition metal complexes containing Schiff bases as ligands due to their application as catalyst and a hydrolytic enzyme in many reactions related to synthetic organic and natural oxygen carriers*. The Cu(II) complex has a square-planar geometry distorted towards tetrahedral. The divalent cations Zn²⁺, Ca²⁺ and Mg²⁺ prevent cytotoxicity Among the transition metals iron, cobalt, nickel, zinc and copper complexes are extensively studied because of their application towards novel biological properties **Crichton (1991)**. Transition metal complexes acts as a homogeneous catalyst in many industrially important reactions such as hydrogenation, hydrosilation, hydroformylation, polymerization, isomerisation, acylation and oxidative hydrolysis of olefins and related

to synthetic organic and natural oxygen carriers **Mutterliuer (1975)** and **Brink - Shoemaker et.al (1964)**. Bimetallic coordination complexes may serve as model for variety of biological reactions such as oxygen transport, oxygen activation, photosynthetic water reduction, the study of electron transfer process, metal-metal interactional multi centered catalysis **Lingappa et al (1996)**. Iron plays an important role in biology, forming complexes with molecular oxygen in hemoglobin and myoglobin. The color of blood is due to the hemoglobin, an iron-containing protein. Finely divided Nickel is used as a catalyst in the hydro generation of oils and fats **Mowton (1980)**. In coenzyme B¹² cobalt is bound to a tetraazamacrocyclic ligand **Nishiya et al (1986)**. In addition to the varied magnetic property and catalytic activities, the transition metal Schiff base complexes can also serve as efficient models for metalloproteins and enzymes. Molecules containing donor-acceptors such as Schiff bases have ability to serve as their implication in biology **Christou et al (1979)**. The structural properties and the reactivity of naturally occurring complexes of these ions in such processes.

EXPERIMENTAL WORK

All the chemicals used were of analar grade. The solvents used were neat and dried. The TLC Plates were

prepared by using silica gel G. Petroleum ether, Ethyl acetate and ethanol were used as irrigants. Microwave oven was used for the irradiation of reactions.

Preparation of Ligands

Preparation of 2-Hydroxy-7-Methyl-quinoline-4-Carboxy Thiosemicarbazone (1)

When equal moles of 7-methyl-quinoline-4-carboxyl chloride and thiosemicarbazone in ethanol was refluxed for 18-22 hours on irradiation give 2-Hydroxy-7-methyl-quinoline-4-carboxy thiosemicarbazone. The completion of the reaction confirmed by thin layer chromatography and the reaction mixture, washed with Petroleum ether and dried.

Melting Point: 174°C.

Yield: 5.2g (87%).

Preparation of 2-hydroxy-7-methyl Quinoline-4-Carboxy Thiosemicarbazone-Schiff base (2)

An ethanolic solution of 0.500g, 7-methyl quinoline thiosemicarbazone was irradiated for 40 seconds with 0.3ml of benzaldehyde which give **7-methyl 2- hydroxy quinoline-4-carboxy thiosemicarbazone-schiff base** the excess solvent was evaporated, washed and recrystallised from ethyl acetate.

Melting Point: 140°C.

Yield : 3.8. g (73%).

Preparation of Copper Complex (3)

An ethanolic solution 0.080g of copper chloride was slowly added to the quinoline semicarbazone Schiff base(III) and the mixture was irradiated for 30 seconds. The reaction mixture was allowed to stand for 2 days at room temperature. A blue coloured needles were obtained.

Appearance: Needles

Color: Blue

Melting point: 230°C.

Preparation of Manganese complex (4)

An ethanolic solution of 0.0756 g of manganese chloride was slowly added to the quinoline semicarbazone Schiff base (2) and the mixture was irradiated for 30 seconds. The reaction mixtures were allowed to stand for 2 days at room temperature. A colourless needle was obtained.

Appearance: Needles

Color: Colourless

Melting point: 218°C.

RESULTS AND DISCUSSION

The present work is focused on the study of co-ordination behavior of thiosemicarbazone Schiffbase with hydrated Cu(II) and Mn(II) chlorides.

The complex thiosemicarbazone Schiff base was obtained via 7-methyl quinoline-4-carboxy-thiosemicarbazone synthesized by refluxing equal moles of 7-methylquinoline -4-carboxylchloride and thiosemicarbazide in ethanol for 18-22 hrs. The 7-methyl quinoline -4-carboxythiosemicarbazone and benzaldehyde in equal moles were refluxed in ethanol for 18hrs at 80°C.

IR spectrum of the compound (1) showed absorption peaks at 1692cm⁻¹(CO), 1670 cm⁻¹(CO), 1635 cm⁻¹(CN of quinoline ring), 1646cm⁻¹(CH=N), 1215cm⁻¹(C=S) **fig(1)**. UV spectrum of the compound showed absorption at 280nm, 271nm, 227nm.

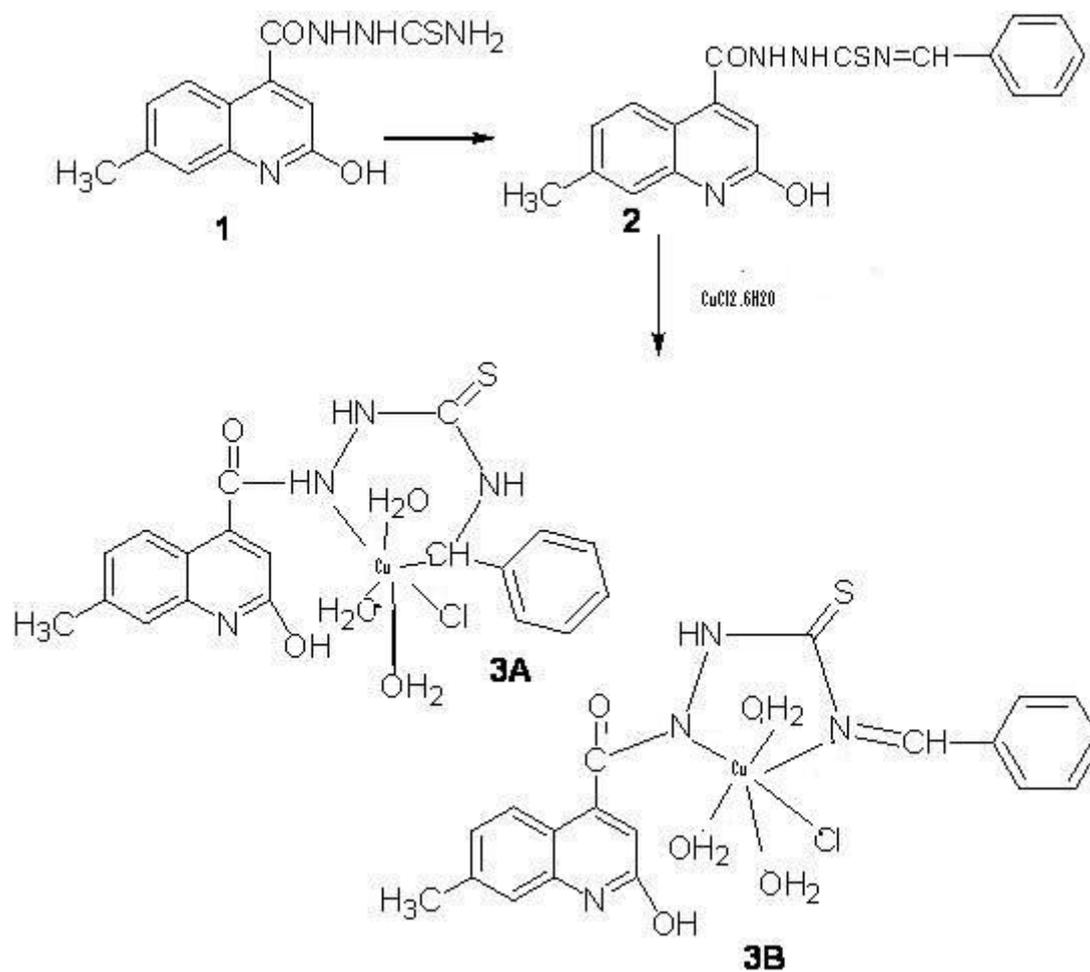
The Schiff base obtained was then irradiated with the ethanolic solution of copper chloride to form the copper complex. 0.500g(0.00031mol) of Schiff base and 0.080g(0.00031mol) of CuCl₂.6H₂O was taken in hot solution of ethanol and irradiated in microwave oven. a blue colour crystal of needle shape was obtained.

IR spectrum of the compound 2-Hydroxy-7-methyl-quinoline-4-carboxy thiosemicarbazone showed absorption peaks at 1699 cm⁻¹(CO), 1672 cm⁻¹(CO), 1680 cm⁻¹(CN of quinoline ring), 1212cm⁻¹(C=S) disappearance of peak at 1636 cm⁻¹.

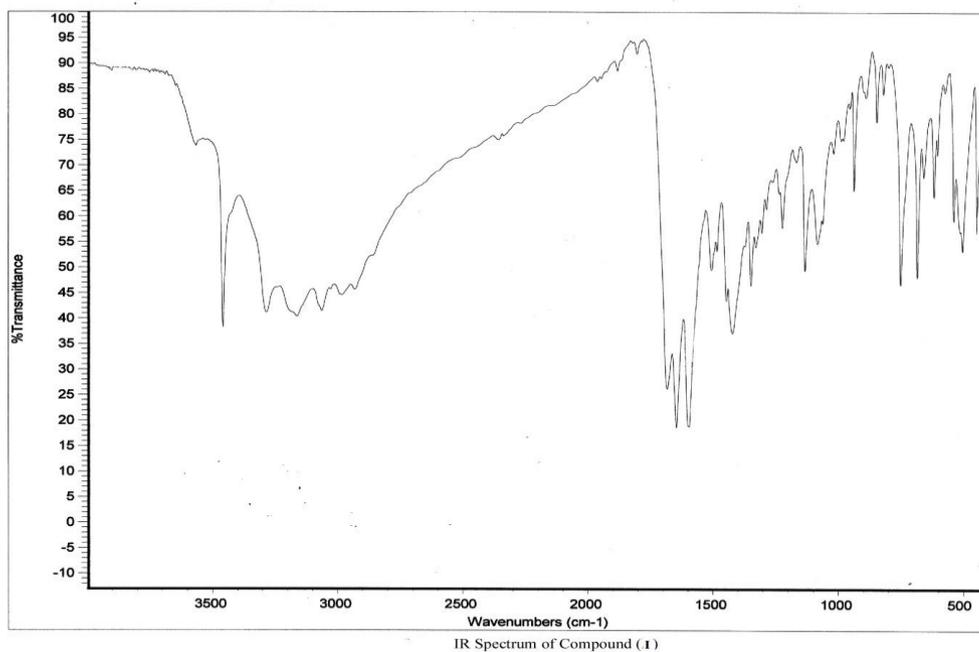
UV spectrum of the compound showed absorption at 280nm, 232nm, a desorption at 279 nm which might be due to the loss of one extended conjugation. Disappearance of peak at 1635 cm⁻¹ interferes that the C=N group of the Schiff base is utilized in the formation of co-ordination between the metal and the complex.

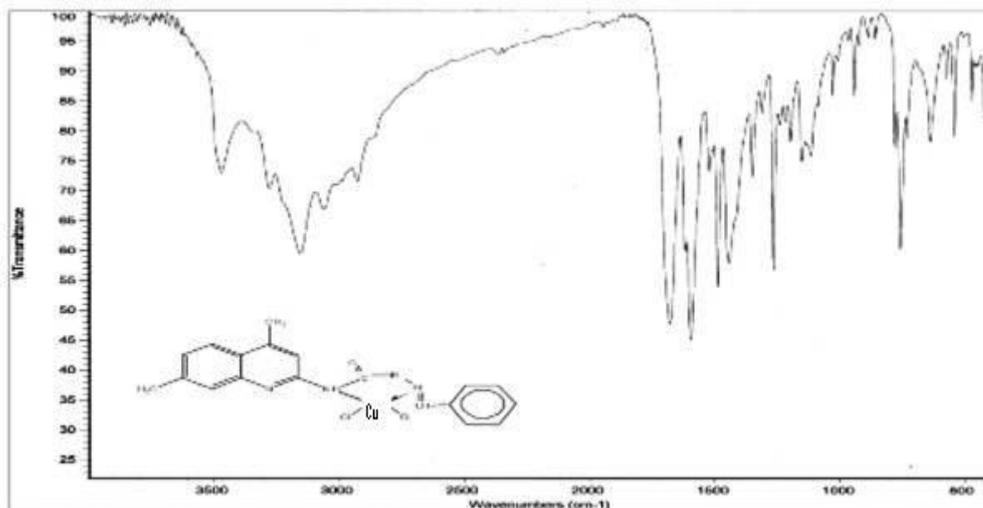
A desorption at 279nm in the UV absorption spectrum indicates the non existence of one extended conjugation during co-ordination.

Thus from the spectral and analytical data the structure of the compound formed was confirmed to be 3A and not 3B.

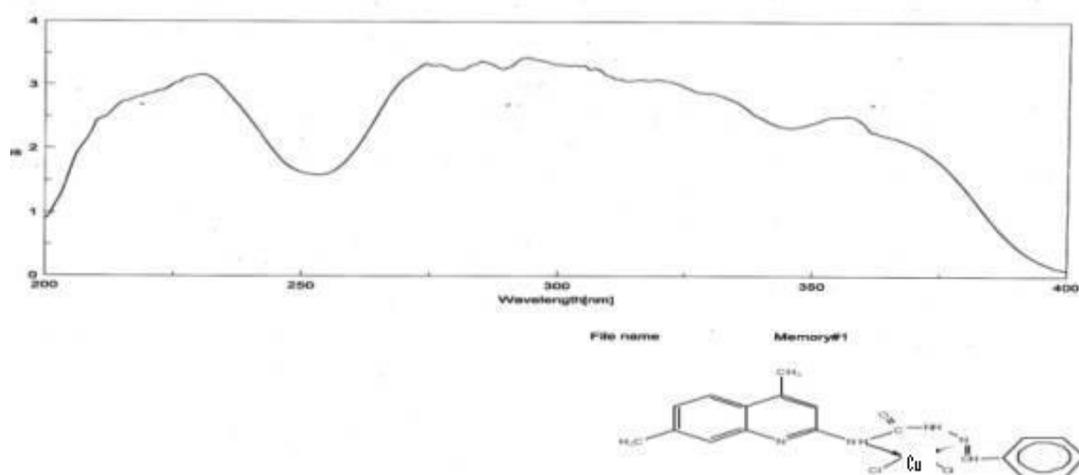


Reaction Scheme for the Formation of Copper Complex.





IR Spectrum of the Compound 3A.



UV Absorption Spectrum of Copper Complex.

The 2-hydroxy-7-methyl quinoline-4-carboxy thiosemicarbazone-schiff base was then subjected to salt to coordinate with manganese to form the manganese complex.

To a hot ethanolic solution of 0.500g(0.00031mol) of Schiff base(2) and 0.0756 g (0.0031mol) of $MnCl_2 \cdot 6H_2O$ in ethanol was added and irradiated in the microwave oven for 50 seconds a colourless needle was obtained.

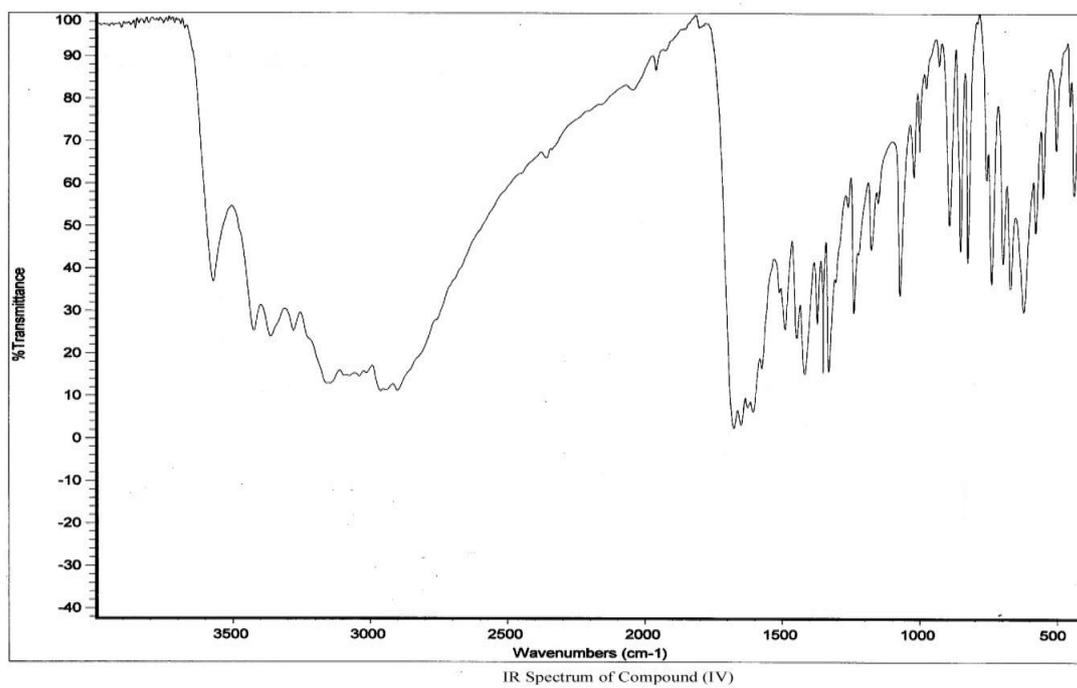
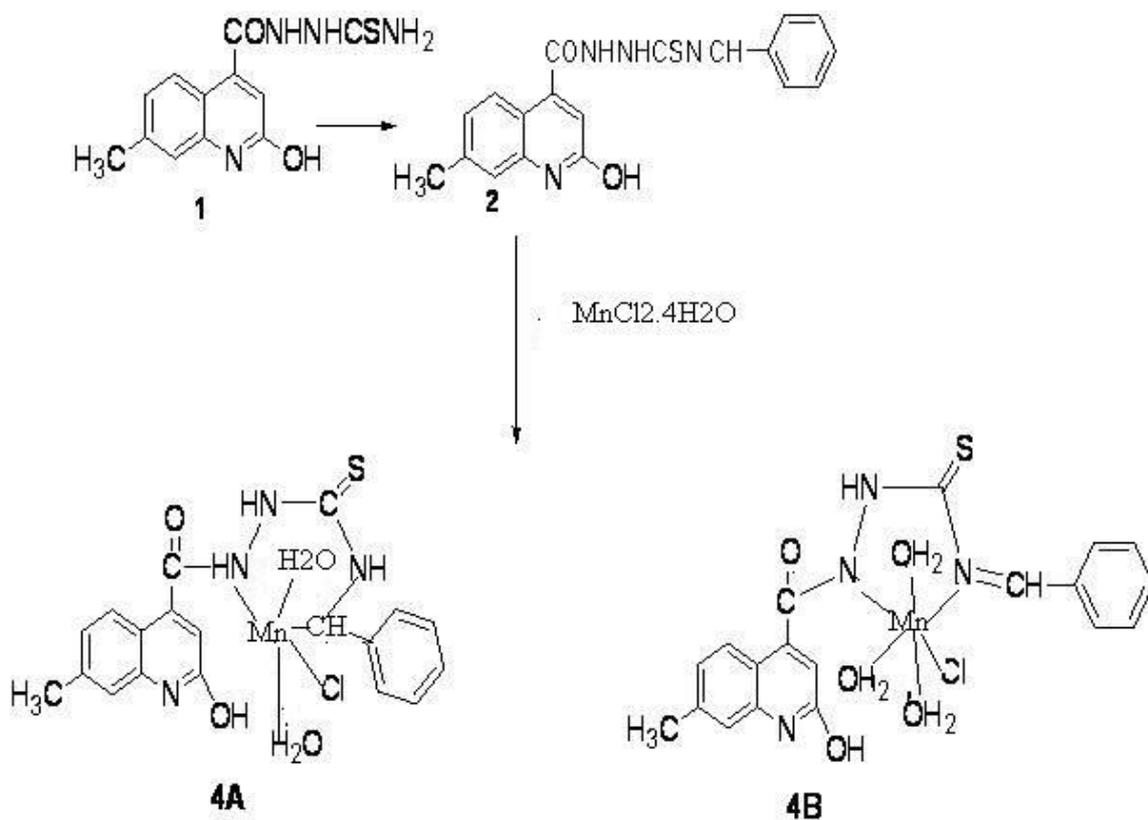
IR spectrum of the compound **2-Hydroxy-7-methyl-quinoline-4-carboxy thiosemicarbazone** showed absorption peaks at 1713 cm^{-1} (CO), 1630 cm^{-1} (CN of quinoline ring); 1611 cm^{-1} (CH=N); 3288 cm^{-1} (NH=C=S \longleftrightarrow N=C-SH); 1213 cm^{-1} and 761 cm^{-1} (-C=S \longleftrightarrow C-SH).

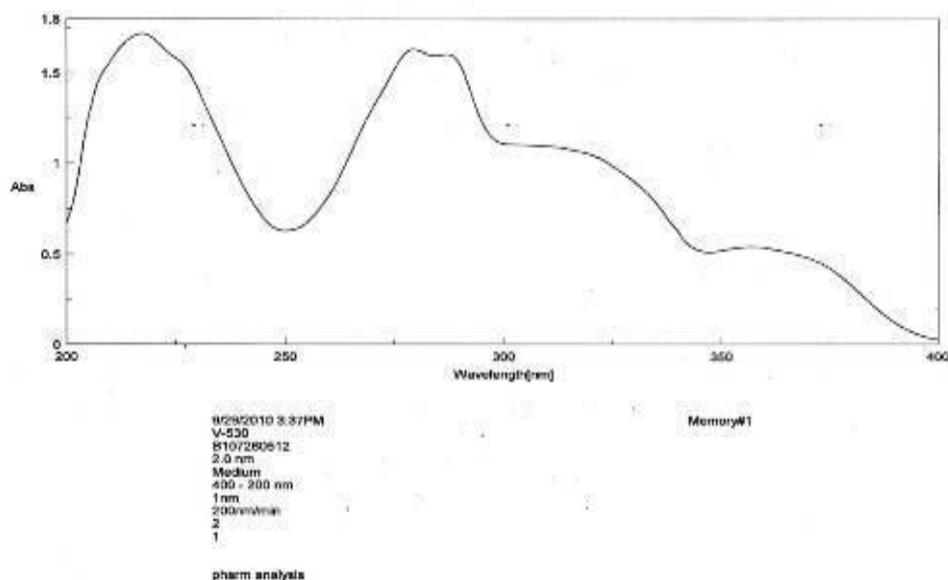
UV spectrum of the compound showed absorption at 302nm, 289nm, 280nm, 235nm Presence of absorption max at 302nm.

The tautomerism in the IR spectrum showed the NH=C moiety is not disturbed during co-ordination.

Absorption at 302nm might be due to the extended conjugation of the ring or may be due to the ring residue. This shows that the the coordination is formed between the lone pair of nitrogen and hence a 5-membered -6- coordination was confirmed.

From the spectral and analytical data the structure of the compound formed was confirmed to be 4B and not 4A.





BIOLOGICAL ACTIVITY

The disc diffusion method uses filter paper discs, 6.0mm in diameter, charged with appropriate concentrations of the drugs. The discs are stored dry in cold. A suitable dilution of a broth culture or a broth suspension of the test bacterium is flooded on the surface of a solid medium (Mueller-Hinton agar). Compounds **1**, **2**, **3A** and **4B** were tested against the bacteria *E. coli* and *Staphylococcus albus* and the fungi *Candida* species and *Aspergillus niger* at various concentrations 100µg/L, 50µg/L, 25µg/L.

ANTIBACTERIAL & ANTIFUNGAL ACTIVITIES

Antibacterial and antifungal activities were carried by Kirby-Bauer Method (Disc diffusion method). The media for antibacterial study is Muller Hinton Agar (MHA). The media for antifungal study is Sabouraud Dextrose Agar (SDA). The standard used was Gentamycin for antibacterial studies. The standard used for antifungal studies was Ketocandazole.

Table-1 shows the antibacterial activity of the compounds **1**, **2**, **3A** and **4B** against *E. coli* and *Staphylococcus albus*. It was found that all the compounds were active. Among the four compounds **3A** and **4B** are active than their precursors.

The antibacterial activity of the compound was almost closer to the standard gentamycin.

Table-2 shows the antifungal activity of the compounds **1**, **2**, **3A** and **4B** against *Candida* species and *Aspergillus niger*. It was found that all the compounds were active. Among the four compounds **3A** and **4B** are active than their precursors.

The Fungi *Candida* species was found to be active than *Aspergillus niger*. *Aspergillus niger* shows only moderate activity.

The antifungal activity of the compound was almost closer to the standard Ketocandazole.

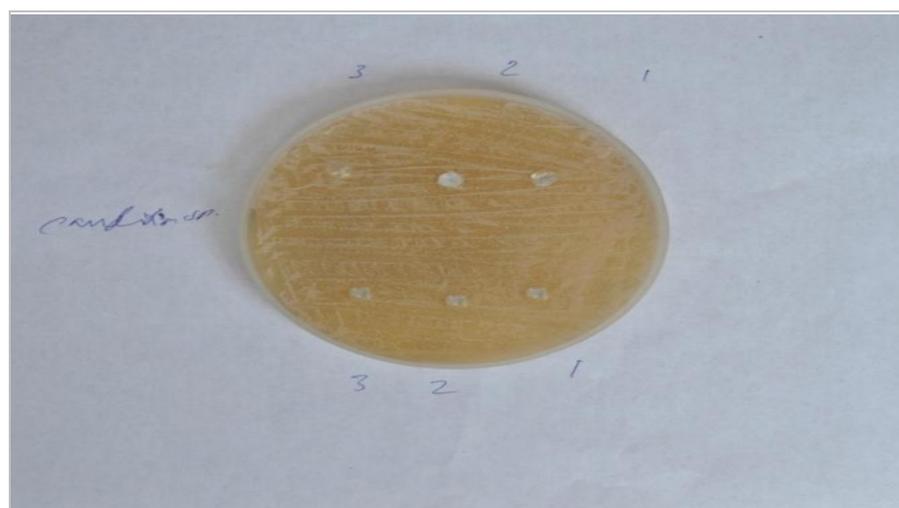
Table-1 Antibacterial Activity.

Samples	Concentrations (100µg/l) (50µg/L) (25µg/L) in mm			Concentrations (100µg/l) (50µg/L) (25µg/L) in mm		
	E.Coli			Staphylococcus albus		
	100µg/L	50µg/L	25µg/L	100µg/L	50µg/L	25µg/L
Compound 3A	5	3	3	5	3	2
Compound 3B	5	4	4	7	5	1
Compound 4A	7	5	4	7	4	2
Compound 4B	7	3	2	8	6	2
Gentamycin	10	8	8	12	10	8



Table-2 Antifungal Activity.

Samples	Concentrations (100µg/l) (50µg/L) (25µg/L) in mm			Concentrations (100µg/l) (50µg/L) (25µg/L) in mm		
	Candida species			Aspergillums niger		
Compound 3A	6	3	4	5	3	2
Compound 3B	5	4	4	4	2	2
Compound 4A	5	3	3	6	2	2
Compound 4B	8	6	2	6	2	2
Ketocandizale	10	8	8	8	6	6



CONCLUSION

Co-ordination behavior of Cu(II) and Mn(II) complexes and the antibacterial activity and antifungal activity were studied in the present work. The acid chloride(1) was reacted with thiosemicarbazide at 80°C for 16-22 hours and to obtained thiosemicarbazone(2). Equal moles of thiosemicarbazone(2) and CuCl₂.6H₂O were irradiated under microwave oven to obtain the complex 3A. Equal moles of thiosemicarbazone(2) and MnCl₂.6H₂O were irradiated under microwave oven to obtain the Mn complex(4B). Analytical and spectral data confirmed the structure of the complex as 3A and 4B. Antibacterial and Antifungal activity were carried out using Disc diffusion method and the compounds were found to be active.

REFERENCES

1. D.E. Fenton, Biocoordination chemistry, Oxford Newyork, Toky, Oxford University Press, P-85 (1995).
2. R.R Crichton, Inorganic Biochemistry of Iron Metabolism, Ellis, Harwood, Newyork, (1991).
3. B.I Mutterliuer, Bull. Soc Bels., 1975; 84: 959.
4. C. Brink - Shoemaker *et.al*, Proc. Roy, Soc., London, Ser. A 1964; 278.
5. Y.Lingappa & K.H. Reddy, Indian j. Chem., a) 1994; 33A: 919, B) 1996; 35a: 775.
6. C.J. Mowton & B.L Shaw, J. Chem. Soc, Dalton trans, 1980; 299.
7. T. Nishiya, S. Yamauchi, N. Hirota, M. Baba & I. Hunazuki, J. Phys Chem., 1986; 90: 5730.
8. Christou, B.Ridge & H.N. Rydon, J. Chem, Commun. (1979) 20.
9. J. Anastassopoulou & T. Theophanides, Bioinorganic Chemistry Volume 459 pp 209-218
10. Albertin G, Bordignon E, Orio A (1975) Five-coordinate copper (II) complexes. Synthesis and properties of [Cu(tren)L]₂⁺ cations. Inorg Chem., 14: 1411-1413.
11. Karlin KD, Zubieta J (1983) Copper Coordination Chemistry: Biochemical and Inorganic Perspectives, New York.
12. Rehman W, Badshah A, Khan S, Tuyet LTA (2009) Synthesis, characterization, antimicrobial and antitumor screening of some diorganotin(IV) complexes of 2-[(9H-Purin-6-ylimino)]-phenol. Eur J Med Chem., 44: 3981-3985.
13. Rehman W, Baloch MK, Badshah A (2008) Synthesis, spectral characterization and bio- analysis

of some organotin(IV) complexes Eur J Med Chem.,
43: 2380-2385.

14. Rosu T, Gulea A, Nicolae A, Georgescu R (2007)
Complexes of 3d(n)metal ions with
thiosemicarbazones: synthesis and antimicrobial
activity. Molecules, 12: 782-796.