

Original Research Article

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## SYNTHESIS, CHARACTERIZATION AND ANTIBACTERIAL STUDIES OF SCHIFF BASE WITH 2-AMINO BENZIMIDAZOLE AND 5-METHYL-THIOPHENE-2-CARBOXALDEHYDE

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**ABSTRACT:** A new Schiff base has been synthesized by condensation of 2-Amino benzimidazole and 5-methyl-thiophene-2-carboxaldehyde. The compound was characterized by FT-IR,  $^1\text{H}$  NMR Spectroscopy,  $^{13}\text{C}$  NMR Spectroscopy to confirm the structure of Schiff base. The Cu(II) and Zn(II) complexes were prepared using the Schiff base. The Schiff base and its metal complexes have been studied for antibacterial activity against the strains such as *Bacillus subtilis*, *Staphylococcus aureus* and *Pseudomonas aeruginosa*, *Escherichia coli*. The metal complexes of Schiff base exhibited more antibacterial activity as compared to Schiff base ligand.

**Keywords:** Schiff base, 2-amino benzimidazole, 5-methyl-thiophene-2-carboxaldehyde, metal complexes.

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### 1. INTRODUCTION

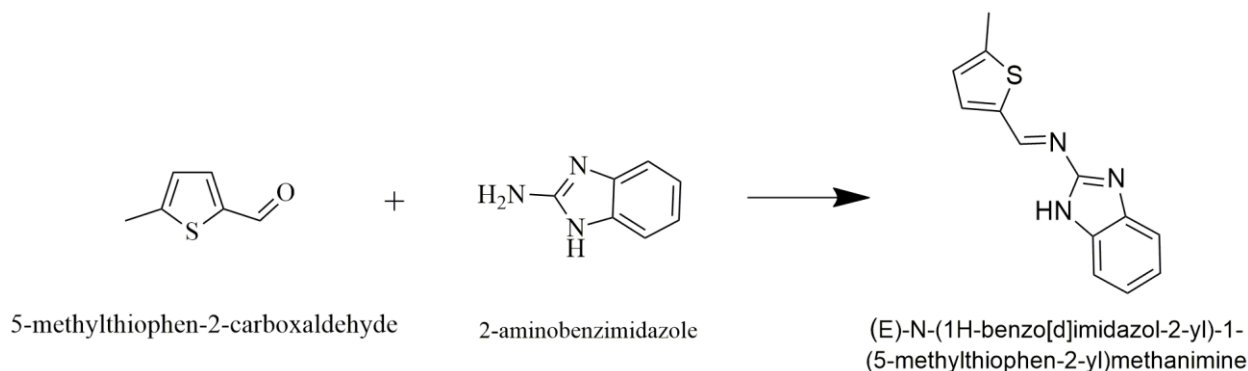
Schiff bases and their metal complexes are used as antibacterial, anti-microbial, anti-fungal, anticonvulsant, anti-HIV, anti-inflammatory, antitumor and catalytic activities [1-6]. Benzimidazoles are known to be a very important class of heterocyclic organic compounds [7-8]. Benzimidazole and their derivatives have various applications in coordination chemistry, photophysics, photochemistry and bioinorganic chemistry [9-15]. Heterocyclic rings having hetero atoms like Sulphur, Nitrogen and Oxygen impart biological activity to these Schiff bases and their metal complexes. Literature review shows that Schiff bases from the benzimidazole derivatives are found to be pharmacologically more important and hence synthesis of 2-substituted benzimidazoles

are the reasonable area of research[16-20].In this study,we synthesized a new Schiff base derivedfrom 2-amino benzimidazole and 5-methyl thiophene-2-carboxaldehyde. Schiff base and its metal complex were characterized and screened for the biological activity. The Schiff base metal complex showed more antibacterial activity thanfree schiff base ligand.

## 2. MATERIALS AND METHODS

### 2.1 Synthesis of ligand

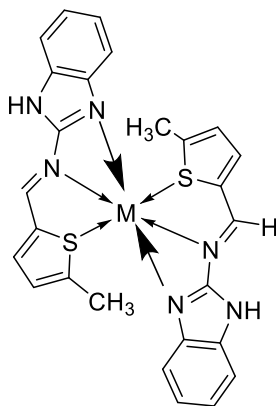
The ligand was prepared by a modification of the reported method [21]. The Schiff base ligand has been synthesized by refluxing a mixture of 0.01 mole of 2-Amino Benzimidazole and 0.01 mole of 5-methyl thiophene 2-carboxaldehyde in ethanol for about 3hr. Schiff base thus formed was cooled to room temperature and collected by filtration, and recrystallized in ethanol and dried. (Figure 1)



**Figure 1: Synthesis of Schiff base ligand**

### 2.2 Synthesis of metal complexes

The procedure employed for the synthesis of metal complexes of the ligand is described below. The metal salts and the ligand were taken in 1:2 molar ratios in methanol. A solution of the appropriate metal salt (4 mmol) ( $MX_2$ , where  $M = Cu(II)$  (or)  $Zn(II)$ ;  $X = Chlorides$ ) dissolved in 25 ml methanol was added to a hot methanolic solution of the ligand (4 mmol). The mixture was refluxed for 6 hrs at 60 °C. The complexes were precipitated by cooling the mixture to room temperature. The obtained solid was filtered and washed with ethanol. Finally, the solid was dried in vacuum desiccators.



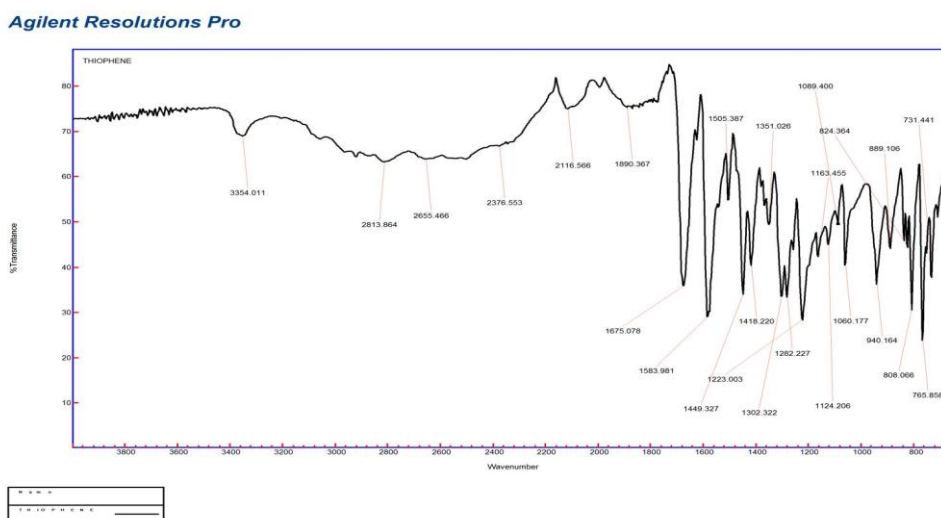
**Figure 2: Structure of schiff base metal complex [M=Cu & Zn].**

### 3. RESULTS AND DISCUSSION

The Schiff base was prepared from 5-methyl-2-thiophenecarboxaldehyde with 2-amino-benzimidazole and its Cu(II), Zn(II) complexes were prepared. All the metal complexes are colored and stable to air and moisture. The complexes are insoluble in common organic solvents like methanol, ethanol and soluble in coordinating solvents like DMF and DMSO. The composition of the complexes is  $ML_2$ , where  $M = Cu(II), Zn(II)$  and  $L =$  ligand.

#### 3.1 Infrared spectra Studies

The FT-IR spectra of schiff base and its metal complexes are shown in the Fig. 3. The strong bands at  $1583\text{ cm}^{-1}$  and  $1675\text{ cm}^{-1}$  characteristic of imine ( $-C=N$ ) stretching vibration of two different imine groups in ligand. In the spectra of schiff base metal complex, the  $-C=N$  group frequency shifted to  $1543\text{ cm}^{-1}$  and  $1584\text{ cm}^{-1}$  respectively which indicates the coordination of metal with Nitrogen atom of the imine groups. The broadband at  $3416\text{ cm}^{-1}$  can be assigned to NH stretching vibration of benzimidazole moiety. The NH stretching band in free schiff base and schiff base metal complexes are nearly in the same frequency indicates that non-coordination of the benzimidazole nitrogen with metal. A sharp band at  $720\text{ cm}^{-1}$  due to  $\nu$  C-S-C group in the Schiff base and it is shifted to higher frequency in the complexes, suggesting the coordination of sulphur atom in thiophenemoiety with the metal ion.



**Figure 3.1: FT-IR Spectra of schiff base ligand**

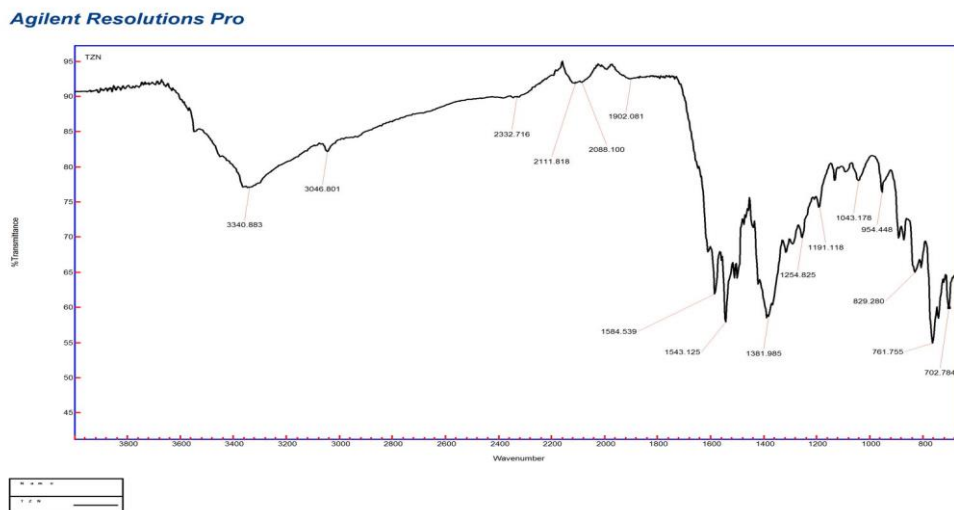


Figure 3.2: IR Spectra of Metal complex

### 3.2 <sup>1</sup>H NMR Studies

The <sup>1</sup>H NMR spectra of the prepared Schiff base is shown in the fig. 4. The peak at 2.5 ppm corresponds to the methyl group hydrogens on the thiophene group. A broad peak around 4 ppm is due to the proton of the -NH group. The peak at 7 ppm can be assigned to the aromatic hydrogens of the benzimidazole ring. The peaks at 6.1 ppm and 7.4 ppm are assigned to the hydrogens of the thiophene group. The peak at 7.7 ppm assigned to the proton on the imine group carbon atom. From the spectra, it is evident that the preparation of Schiff base was successful by condensation of aldehyde of thiophene with amine of benzimidazole.

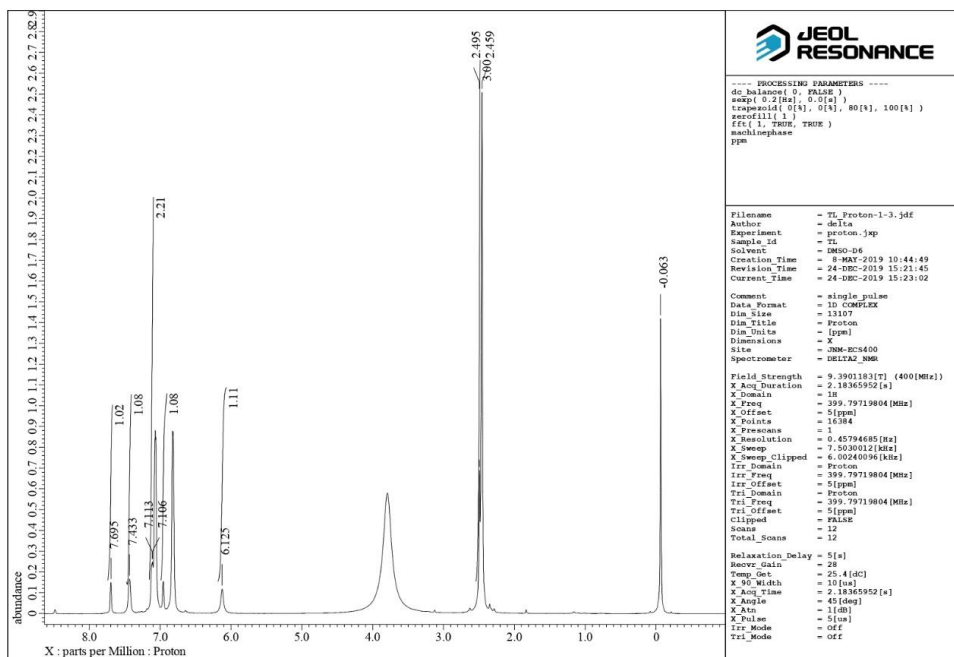


Figure 4: <sup>1</sup>H NMR spectra of the ligand

### 3.3 $^{13}\text{C}$ NMR Studies

The  $^{13}\text{C}$  solid state NMR spectra of prepared Schiff base is shown in Fig.5. From the spectra, the peak at 16 ppm is due to the Carbon of  $-\text{CH}_3$  group on the thiophene ring. The peaks at 112 ppm, 119 ppm, 138 ppm are assigned to the aromatic ring carbon atoms. The remaining peaks at 122 ppm, 128 ppm, 149 ppm are assigned to carbon atoms of the thiophene group of the Schiff base. Mainly, the peak at 156 ppm is assigned to the carbon of the imine group which gives information about the formation of Schiff base due to condensation of aldehyde with amine and peak at 158 ppm is due to the carbon of the benzimidazole group.

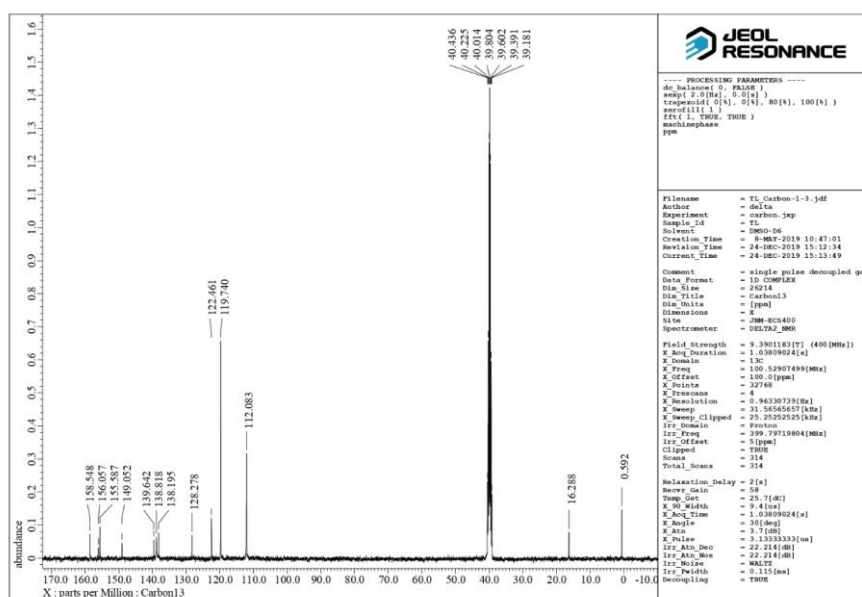


Figure 5:  $^{13}\text{C}$  NMR spectra of the ligand

## 4. Biological Applications

### 4.1 Antibacterial activity

The antibacterial activity of the prepared schiff base and its metal complexes were studied against gram positive (*Staphylococcus aureus*, *Bacillus subtilis*) and gram negative (*Escherichia coli*, *Pseudomonas aeruginosa*) bacteria. Tetracycline was taken as the reference antibacterial agent. The solutions of the compounds and reference drug were dissolved in DMSO. From the table-1, it is clear that the schiff base complexes of Cu(II) and Zn(II) metals are more active than the free ligand. Zinc complex of the schiff base ligand showed higher activity than the other complex.

**Table 1: Antibacterial activity of Schiff base and its metals complexes**

Compound	<i>S.aureus</i>	<i>Bacillus</i>	<i>Pseudomonas</i>	<i>E.coli</i>
Ligand	11mm	14mm	10mm	11mm
Cu(L) <sub>2</sub>	<b>10mm</b>	<b>15mm</b>	10mm	8mm
Zn(L) <sub>2</sub>	12mm	17mm	9mm	15mm
Tetracycline	10mm	15mm	10mm	12mm

#### 4. CONCLUSION

A new schiff base was prepared by condensation of 2-aminobenzimidazole and 5-methyl thiophene-2-carboxaldehyde. The Cu(II) and Zn(II) schiff base metal complexes were prepared and characterized by FT-IR spectroscopy, <sup>1</sup>H & <sup>13</sup>C NMR Spectroscopy. The prepared Schiff base act as a neutral tridentate ligand. The metal complexes are formed by coordination of metals [Cu(II) and Zn(II)] with the nitrogen of azomethine group as well as benzimidazole nitrogen and sulphur atom of the thiophene ring of the schiff base. The prepared schiff base and its metal complexes are screened for the biological activity against gram positive (*Staphylococcus aureus*, *Bacillus subtilis*) and gram negative (*Escherichia coli*, *Pseudomonas aeruginosa*) bacteria. It is found that, the schiff base metal complexes showed higher biological activity than the free schiff base ligand.

#### ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

#### HUMAN AND ANIMAL RIGHTS

No Animals/Humans were used for studies that are base of this research.

#### CONSENT FOR PUBLICATION

Not applicable.

#### AVAILABILITY OF DATA AND MATERIALS

The author confirms that the data supporting the findings of this research are available within the article.

#### CONFLICT OF INTEREST

The authors have no conflict of interest.

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