INTRODUCTION

Benzimidazole is an important pharmacophore in modern drug discovery. Mannich bases of benzimidazole derivatives exhibit diverse pharmacological activities like antimicrobial [1], analgesic [2], antiinflammatory [3], anthelmintic [4], antiviral [5] as well as antitumor [6], etc. The benzimidazole contains a phenyl ring fused with imidazole ring [7]. In addition to their biological importance, benzimidazoles form stable complexes with various transition metals [8]. Transition metal complexes of 2-substituted benzimidazole and benzimidazole based mixed ligands have been reported with mono-, bi-, and tridentate coordination behaviour [9-13]. The continuous increase in bacterial resistance to the existing drugs have been resulted due to widespread use of antibacterial agents leading to research on new substances possessing antimicrobial activity [14,15]. Several benzimidazoles are commercially available as pharmaceuticals veterinary products and fungicides.

EXPERIMENTAL

All the reagents and solvents were purchased from Sigma-Aldrich and used as received. IR spectra were recorded with KBr pellets using FT-IR Shimadzu instrument. Electronic spectra were recorded by using a Shimadzu-UV-Vis-Spectrophotometer in 10⁻⁴ M solution of the compound in dimethyl formamide (DMF) at 25 °C with 1 cm quartz cell. ¹³C NMR and ¹H NMR were recorded in DMSO-d₆ on Bruker NMR spectrometer using TMS as internal reference.

RESULTS AND DISCUSSION

The IR spectra of the complexes indicate that ligand behaves as a bidentate and coordinate to metal via N-(C-NH). In the ligand, band appearing at 3456 cm⁻¹ due to NH stretching is shifted to lower wave number at 3456-3211 cm⁻¹ in the complexes by confirming the coordination through the nitrogen atom. All the complexes exhibit 695-622 and 548- 466 cm⁻¹ assignable to ν(M-O) and ν(M-N), respectively (Table-1).

Electronic spectra: The electronic spectra of the ligand and its metal complexes were recorded in DMF solution. The
The electronic spectra of the ligand showed an absorption bands at 324 and 282 nm attributed to n→π* and π→π* transitions. The electronic spectra of ligand and its metal complexes were summarized in Table-2.

**TABLE-2**

<table>
<thead>
<tr>
<th>Compounds</th>
<th>λ max (nm)</th>
<th>Transition assignment</th>
<th>Geometry</th>
</tr>
</thead>
<tbody>
<tr>
<td>BNH (Ligand)</td>
<td>282</td>
<td>π→π*</td>
<td>–</td>
</tr>
<tr>
<td>Fe–BNH</td>
<td>366</td>
<td>n→π*</td>
<td>Octahedral</td>
</tr>
<tr>
<td>Ni–BNH</td>
<td>325</td>
<td>n→π*</td>
<td>Octahedral</td>
</tr>
<tr>
<td>Co–BNH</td>
<td>311</td>
<td>π→π*</td>
<td>Octahedral</td>
</tr>
<tr>
<td>Zn–BNH</td>
<td>318</td>
<td>π→π*</td>
<td>Octahedral</td>
</tr>
</tbody>
</table>

**1H NMR spectra:** The 1H NMR spectra of ligand shows CH proton signal at δ = 2.56 ppm. The NH proton signal was observed as δ = 8.127 ppm for benzimidazole. The phenyl proton signals of phenyl ring was located at δ = 7.26 ppm and the pyridine proton signals of pyridine ring was located at δ = 8.59 ppm.

**13C NMR spectra:** The 13C NMR shows a peak at 149 ppm is for -CH carbon, the peaks at 126-134 ppm signifies aromatic carbon. A peak at 164.1 ppm indicates the presence of amide carbon. The proton 1H NMR and 13C NMR of ligand have confirmed the suggested structure of the ligand.

**Antibacterial activity:** All the compounds were screened in vitro for their antibacterial activity against *Salmonella typhi*, *Staphylococcus aureus* and *Escherichia coli* by well diffusion method. The zone of inhibition values were found out at the end of 24 h at 37 ºC for the bacterial stains. The antibacterial data (Table-3) suggested that Mannich base derivative of benzimidazole were found to be biologically active. It is observed that growth inhibiting activity of metal complexes of Mannich bases is superior when compared with the ligand.

**Conclusion**

The ligand (BNH) and its metal complexes have been synthesized and characterized by IR, UV and NMR spectral techniques. It is revealed from the IR studies that the ligand coordinated to metal as a bidentate ligand. The UV spectral studies confirm the octahedral geometry of the complexes (Fig. 1). The 1H NMR and 13C NMR spectra showed that the number of hydrogen atoms present in the ligand were exacted when compared with the numbers of hydrogen atoms in the ligand (BNH) and its metal complexes.
expected compounds. The antibacterial screening of ligand and its metal complexes showed the excellent activity.

REFERENCES