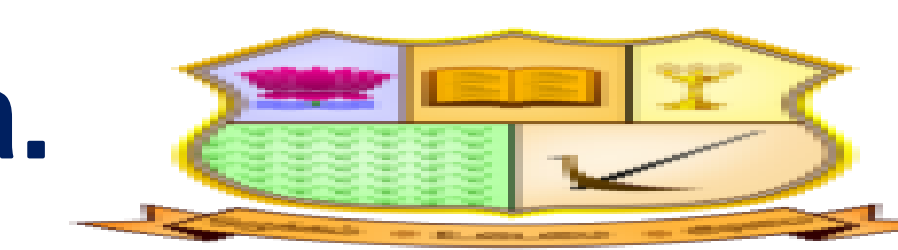


Synthesis, Spectral, Antimicrobial Investigation of Piperazine-1,4-dium Based Two Nitrogen Containing Organic Complexes with Biphenyl-4,4'-bis(olate)

Karunanithi Suganya*, Dhurairaj Satheesh, Sundaram Manjunathan**

PG and Research Department of Chemistry, Loganatha Narayanaswamy Government College (Autonomous), Ponneri – 601 204, Tamilnadu, India.

*Presenting Author: E-mail: suganyakarna4@gmail.com; **Corresponding author(s): Email: satheeshvdm@ingovernmentcollege.com,



ABSTRACT

In this present investigation, new diprotic piperazinium based nitrogen containing two organic complexes, namely Piperazine-1,4-diium biphenyl-4,4'-bis(olate) (**PDBP-4,4'-BO**) and (2R,5S)-2,5-dimethylpiperazine-1,4-diiumbiphenyl-4,4'-bis(olate) (**2,5-DMPDBP-4,4'-BO**) were synthesized through the simple proton transfer reaction between Piperazine and Biphenyl-4,4'-diol (**BPD**) by strring method at room temperature. After completion of proton transfer, two orgnic complexes **PDBP-4,4'-BO** and **2,5-DMPDBP-4,4'-BO** were achieved with an excellent yield. The synthesized diprotic piperazinium complexes **PDBP-4,4'-BO** and **2,5-DMPDBP-4,4'-BO** were characterized successfully and their formation were confirmed by analytical (Colour, physical state and elemental analysis) and spectral studies such as FT-IR, ¹H and ¹³C NMR spectroscopy techniques. This methodology involves simple procedure, room temperature reaction and environmentally friendly conditions. The **PDBP-4,4'-BO** and **2,5-DMPDBP-4,4'-BO** were screened to their antibacterial (*Staphylococcus aureus*, *Enterococcus sp*, *Escherichia coli* and *Klebsiella pneumoniae*) and antifungal (*Candida albicans*) activities. The standard drugs, *Nalixidix acid*, *Chloramphenicol* and *Fluconazol* were used for this study against gram-positive, gram-negative bacteria and fungi respectively. The standard drugs were used in this study, they were not shown antibacterial and antifungal activity in all the tested concentrations. The **PDBP-4,4'-BO** has been shown an excellent antibacterial and antifungal activity compared to the tested **2,5-DMPDBP-4,4'-BO** and their corresponding standard drugs (*Nalixidix acid*, *Chloramphenicol*). The **2,5-DMPDBP-4,4'-BO** was shown an excellent activity compared to **PDBP-4,4'-BO** and standard drug (*Fluconazol*).

INTRODUCTION TO IONIC LIQUIDS

Ionic liquids, also known as liquid salts, are a unique class of liquids that exhibit fascinating properties and have garnered significant attention in recent years. Unlike traditional molecular liquids composed of neutral molecules, ionic liquids are made up entirely of ions. These ions, which can be organic or inorganic, provide the liquid with its distinct characteristics such as low volatility and high thermal stability. The absence of volatile molecules makes them non-flammable and potentially safer alternatives to conventional organic solvents. Additionally, their wide electrochemical window and exceptional solvation capabilities have led to numerous applications in various fields including green chemistry, energy storage, catalysis, and electrochemistry. In this article, we explore the intriguing properties and promising applications of these remarkable substances known as ionic liquids.

Properties and Characteristics of Ionic Liquids

Ionic liquids are a unique class of substances known for their distinctive properties and characteristics. Unlike traditional liquids, they consist entirely of ions, giving them a low melting point and high thermal stability. One notable feature is their negligible vapor pressure, which makes them non-volatile and less prone to evaporation compared to conventional solvents. Ionic liquids also exhibit wide liquidus ranges, enabling them to remain in the liquid state over a broad temperature range. Their high ionic conductivity allows for efficient charge transfer, making them excellent electrolytes in various electrochemical applications. Additionally, their tunable physicochemical properties make them versatile solvents for a wide range of compounds, including organic and inorganic materials.

Applications of Ionic Liquids In Chemistry

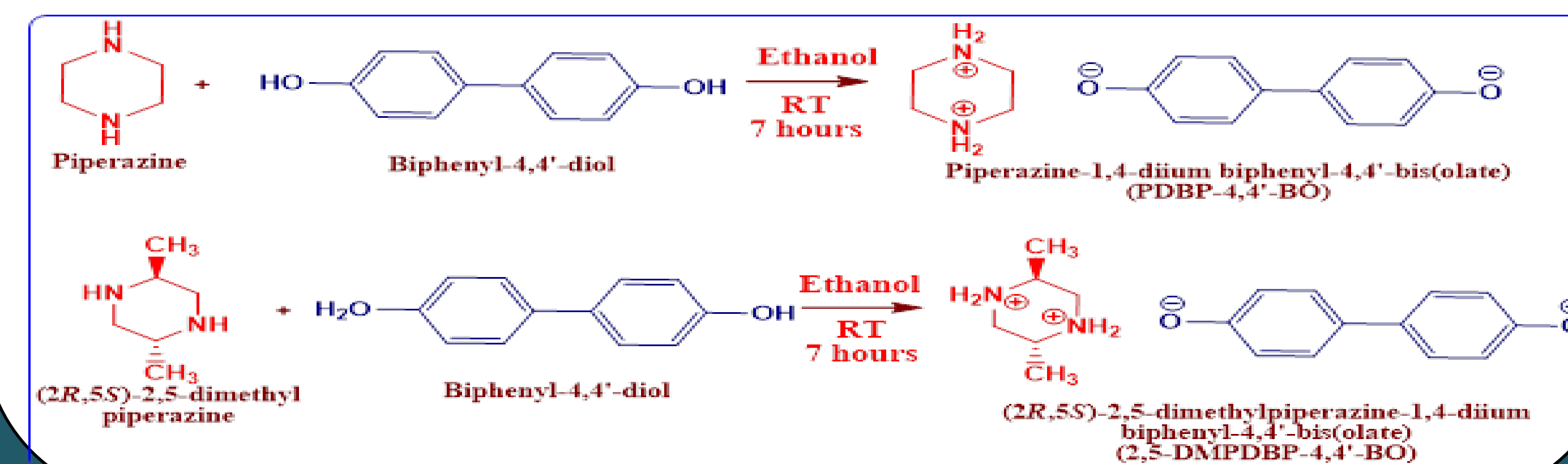
Ionic liquids have gained significant attention in chemistry due to their unique properties and versatility, leading to various applications across different fields. In organic synthesis, they act as efficient solvents for catalysis, extraction, and separation processes. Ionic liquids also find application as electrolytes in batteries and fuel cells due to their high conductivity and stability. They can be used as reaction media for the synthesis of nanomaterials, facilitating precise control over particle size and morphology. Furthermore, ionic liquids serve as green solvents for biomass processing and biofuel production, offering enhanced efficiency compared to traditional organic solvents. Their ability to dissolve a wide range of compounds makes them suitable for chemical analysis techniques such as spectroscopy and chromatography.

AIM & OBJECTIVES

- ❖ To synthesis new diprotic piperazinium based nitrogen containing two organic complexes, namely Piperazine-1,4-diium biphenyl-4,4'-bis(olate) (**PDBP-4,4'-BO**) and (2R,5S)-2,5-dimethylpiperazine-1,4-diiumbiphenyl-4,4'-bis(olate) (**2,5-DMPDBP-4,4'-BO**).
- ❖ To Characterize **PDBP-4,4'-BO** and **2,5-DMPDBP-4,4'-BO** by FT-IR & NMR study.
- ❖ To screen their antibacterial (*Staphylococcus aureus*, *Enterococcus sp*, *Escherichia coli* and *Klebsiella pneumoniae*) and antifungal (*Candida albicans*) activities.

SYNTHESIS

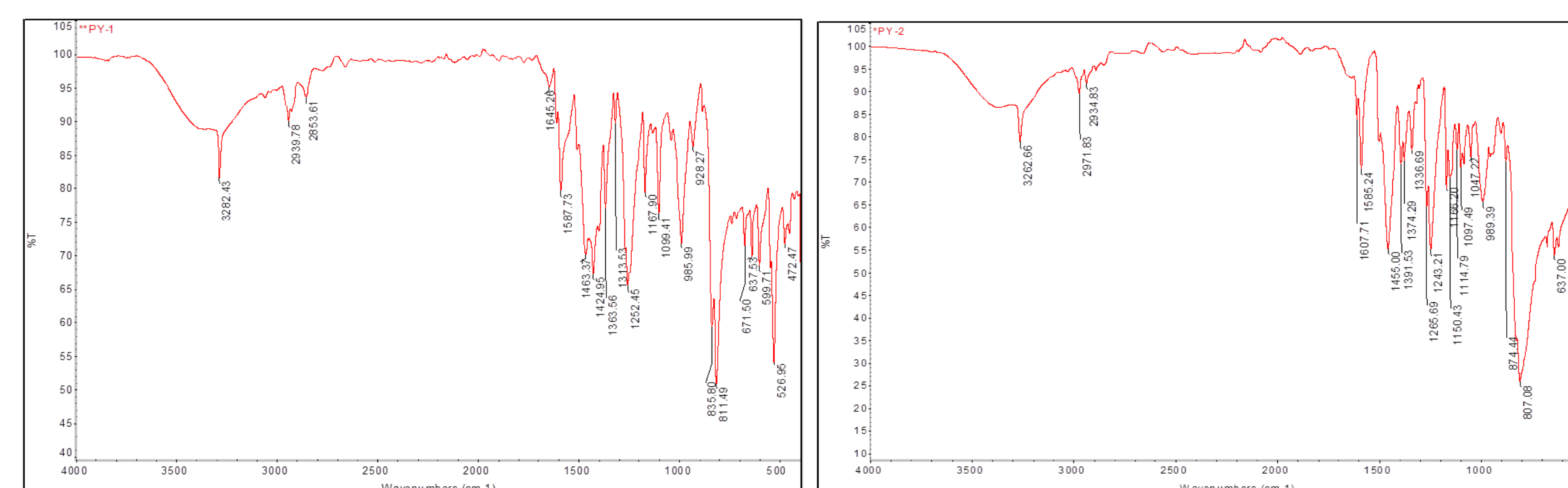
1:1 ratio of 2.0 mmol of Piperazine base and 2.0 mmol of Biphenyl-4,4'-diol were added to a mixture of 10 mL of ethyl acetate and 10 mL of absolute ethanol in a tightly closed RB-flask to prevent solvent evaporation and the reaction mixture was stirred vigorously at room temperature for 6 hours. After the reaction was completed, the solution was allowed to evaporate slowly and then obtained precipitate crystallized from ethyl acetate and absolute ethanol mixture (3:2, 5 mL) to yield Piperazine-1,4-dium Biphenyl-4,4'-bis(olate).



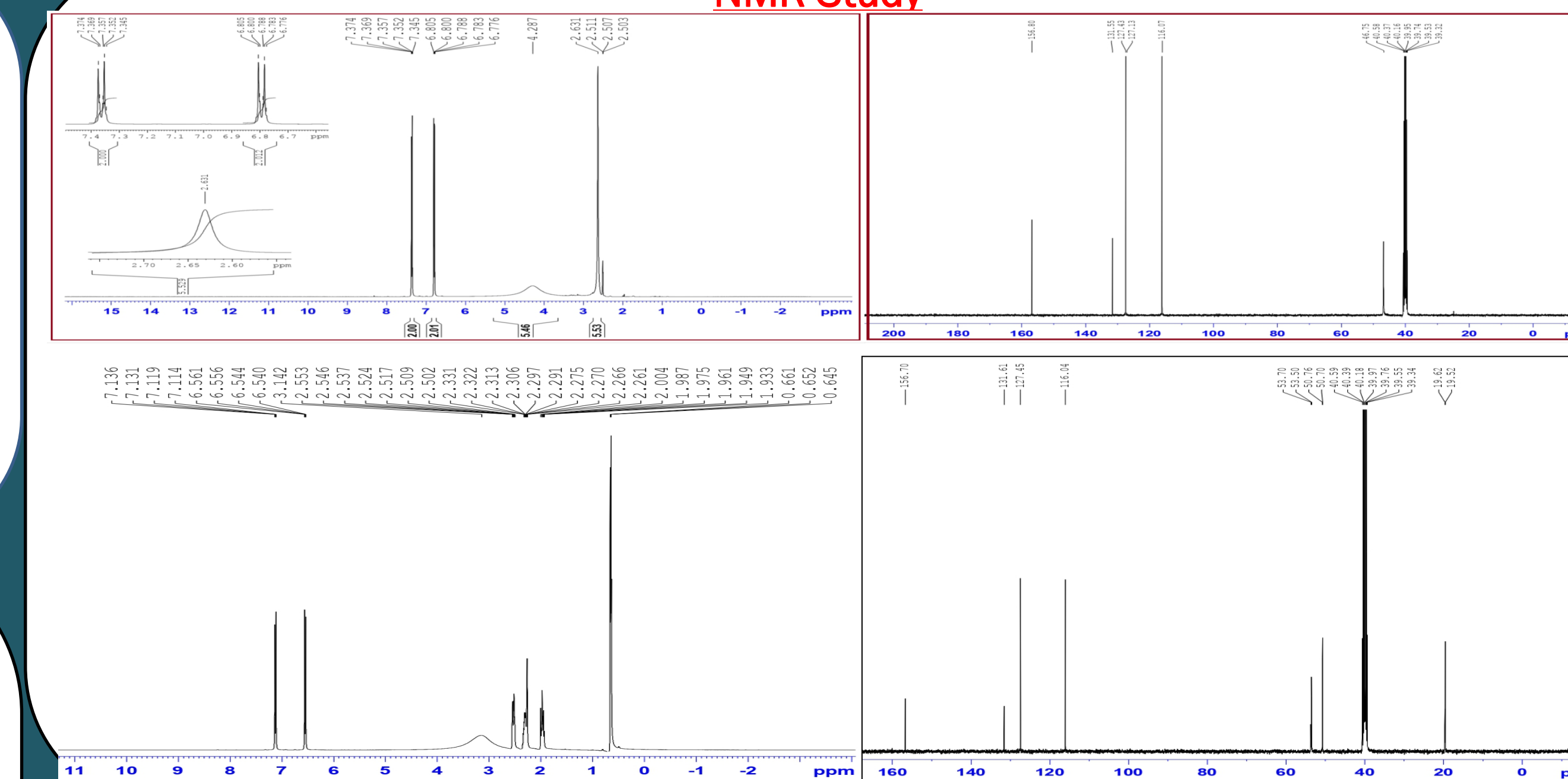
RESULTS AND DISCUSSION

FT-IR Study

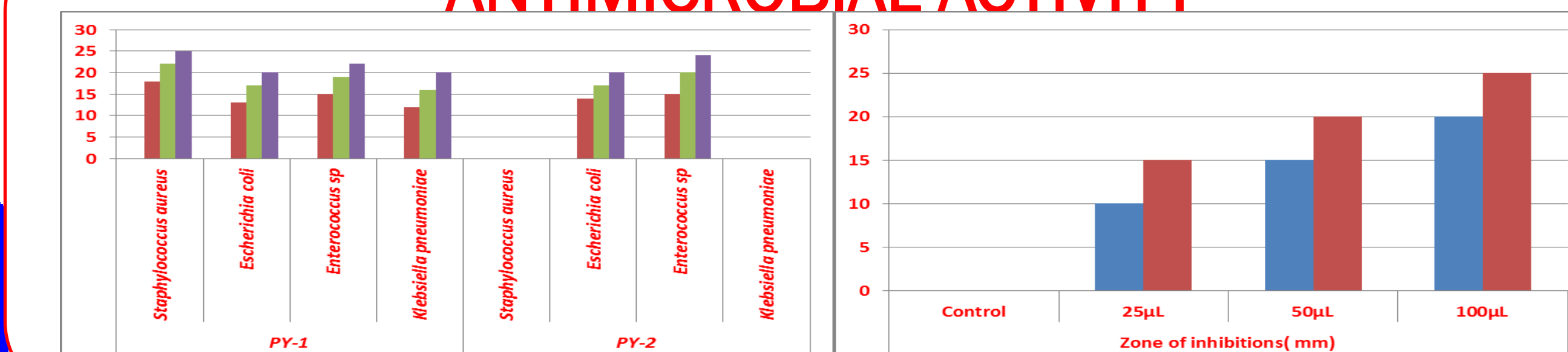
- ❖ vNH stretching modes is 3282 cm^{-1} , 3262 cm^{-1} ,
- ❖ vCO stretching mode is 1167 cm^{-1} , vw
- ❖ Absence of free phenolic -OH stretching mode



NMR Study



ANTIMICROBIAL ACTIVITY



CONCLUSION

- ✓ The successful synthesis of two new diprotic piperazinium salts PDBP-4,4'-BO and 2,5-DMPDBP-4,4'-BO
- ✓ The structure and formation of diprotic piperazinium salts were confirmed by FT-IR and NMR spectral study.
- ✓ The salt PDBP-4,4'-BO shown an excellent anti-bacterial activity compared to 2,5-DMPDBP-4,4'-BO standard drugs.
- ✓ The salt 2,5-DMPDBP-4,4'-BO shown an excellent anti-fungal activity compared to PDBP-4,4'-BO and standard drug.

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- ❖ The authors also thank the VIT University, Vellore for spectral studies and Biochemie lab for biological studies, India.

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