

Antibacterial Potential of 2-Benzoylpyridine *N*-(bicyclo[2.2.1]hept-2-yl)thiosemicarbazone and Its Copper(II) Complexes Towards *Bacillus cereus*

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INTRODUCTION & AIM

Bacillus cereus is a widespread Gram-positive bacterium that can cause severe foodborne illnesses, opportunistic infections, and even life-threatening conditions such as endophthalmitis and bacteremia. Its pathogenic potential, combined with the ability to produce toxins and form resistant spores, makes it a serious public health concern. In recent years, the problem has been exacerbated by the increasing occurrence of antibiotic resistance in *B. cereus*, which reduces the effectiveness of conventional treatments. Therefore, the discovery and development of new drug candidates with strong antibacterial activity against *B. cereus* is of great importance. Since thiosemicarbazones and their metal coordination complexes, especially copper(II) complexes are frequently associated with pronounced antibacterial properties, the aim of the present study was the synthesis of novel thiosemicarbazone-based complexes and the evaluation of their antibacterial efficacy against *Bacillus cereus*.

METHOD

In the present study, we report the synthesis of 2-benzoylpyridine *N*-(bicyclo[2.2.1]hept-2-yl)thiosemicarbazone (HL) (Figure 1) and three corresponding copper(II) coordination compounds: [Cu(L)NO₃], [Cu(L)Cl], and [Cu(L)CHCl₂COO]. The design of the ligand was based on a camphor-derived structural fragment, chosen due to the ability of such derivatives to display enhanced biological activity compared to their parent natural products. The thiosemicarbazone was prepared through a two-step synthetic procedure, followed by complexation reactions with appropriate copper(II) salts in ethanol in 1:1 molar ratio. The physicochemical characteristics of all synthesized compounds were examined to verify their composition and structure using several analytical techniques, including ¹H and ¹³C NMR spectroscopy, FTIR spectroscopy, X-ray diffraction analysis, elemental analysis, and molar conductivity measurements.

The minimum inhibitory concentrations (MICs, µg/mL) and minimum bactericidal concentrations (MBCs, µg/mL) were determined by the serial dilution method in liquid medium. The tested compounds were initially dissolved in DMSO at a concentration of 10 mg/mL, followed by subsequent dilutions prepared in 2% peptone broth.

RESULTS & DISCUSSION

The HL did not exhibit activity, however, its copper(II) complexes demonstrated strong results, surpassing the activity of Furacillinum, an antimicrobial drug used in medicine (Figure 2). The activity of the copper(II) complexes is significantly influenced by the counterion, with the activity increasing in the following order: NO₃⁻ > Cl⁻ > CHCl₂COO⁻. The most active compound is complex [Cu(L)NO₃], with MIC and MBC values of 0.24 µg/mL, which is 20 times higher than the activity of Furacillinum.

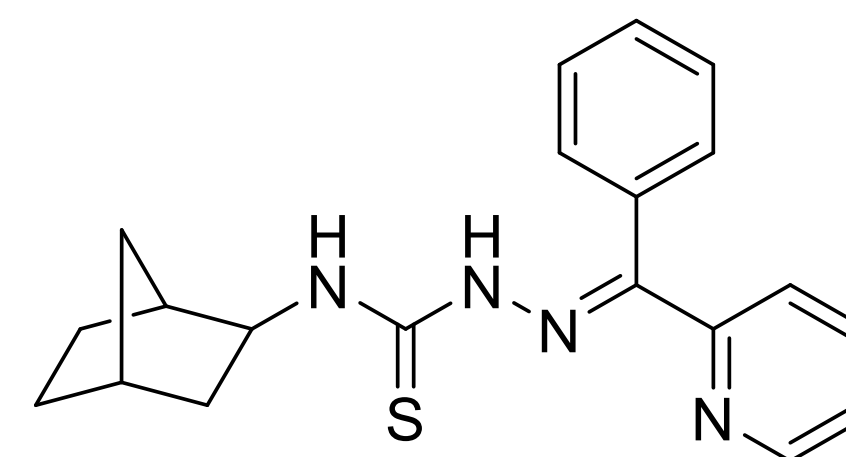


Figure 1. The structural formula of HL

Antibacterial activity towards *B. cereus*

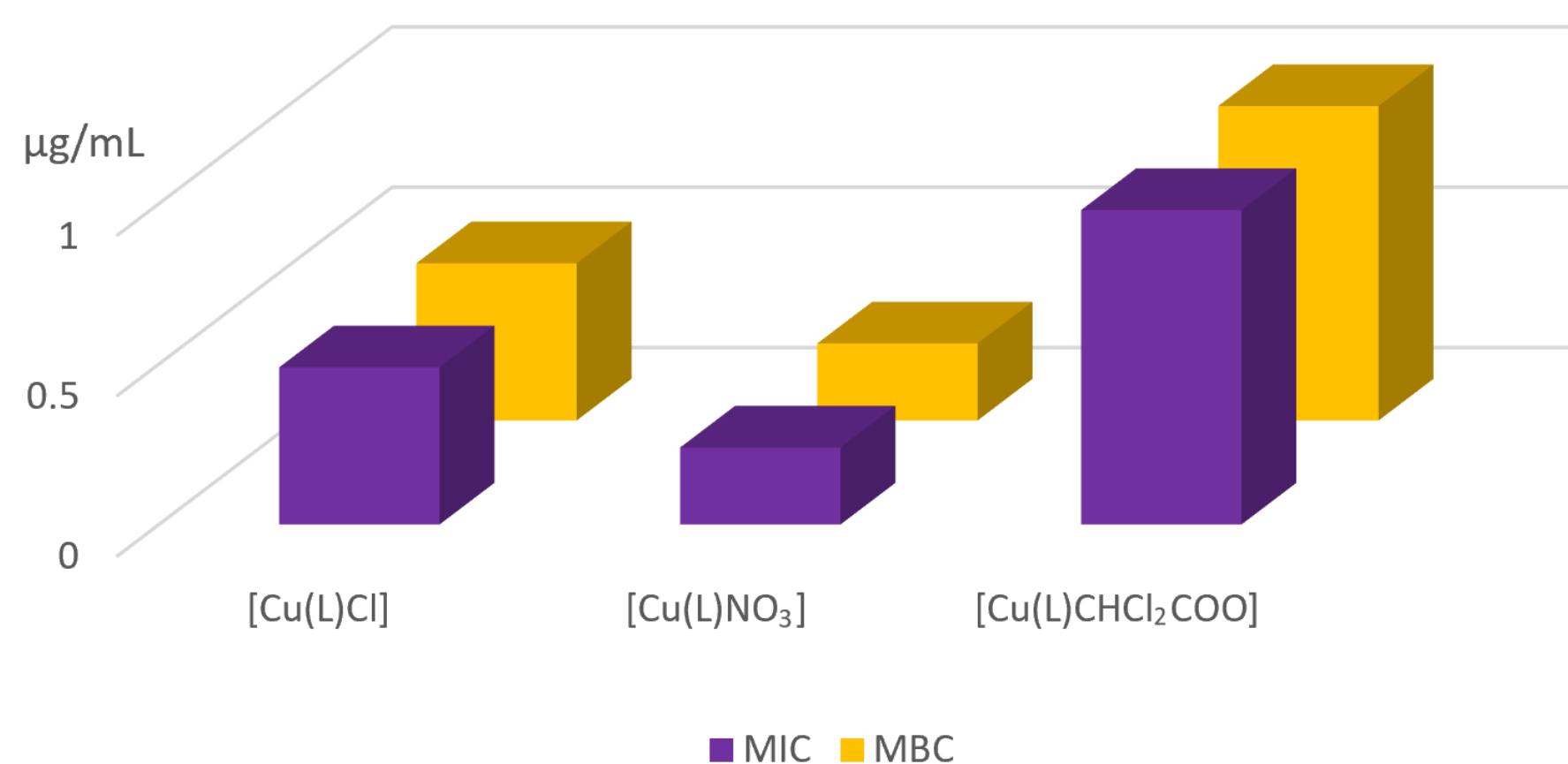


Figure 2. The activity of copper(II) complexes

CONCLUSION

The results of this study primarily confirm that thiosemicarbazones and their complexes can serve as potential antibacterial agents, exhibiting higher activity than some of the currently used drugs. Coordination of the thiosemicarbazone to the central copper(II) atom leads to a significant increase in the activity of the resulting complexes. Furthermore, the findings of this work make it possible to trace the influence of the counterion on the studied compounds, demonstrating that the counterion has a considerable impact on their antibacterial activity.

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