

**SYNTHESIS, STRUCTURE, AND BIOLOGICAL ACTIVITY OF COPPER, NICKEL,  
AND ZINC COMPLEXES WITH  
2-BENZOYLPYRIDINE 4-MORPHOLINETHIOSEMICARBAZONE**

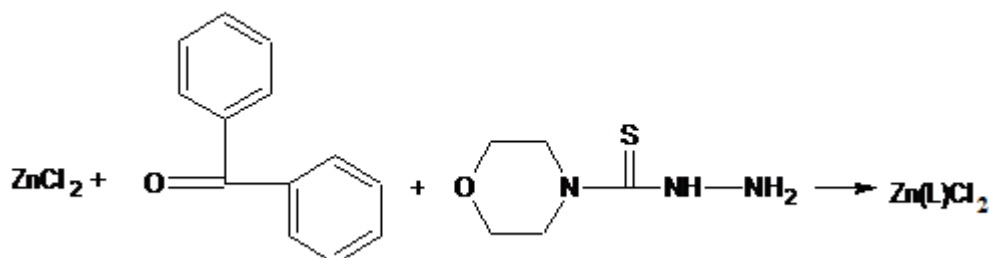
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Thiosemicarbazones are of considerable interest because of their potentially beneficial biological activities, such as antitumor, antibacterial, antiviral, and antimalarial activities. Some of them are already used in medical practice. It is found that in many cases, their useful properties correspond well to their ability to form chelates with metal ions. Biological activities of the metal complexes differ from those of either the ligand or the metal ion itself. Increased and/or decreased biological activities are reported for various metal complexes as well as the well-studied copper(II), zinc(II), and iron(III). Therefore, the synthesis and study of the structural characteristics of copper, nickel and zinc coordination compounds with thiosemicarbazones are of both practical and scientific interest. In our research coordination compounds were obtained by template synthesis. A solution of copper, nickel or zinc salt was added to an ethanol solution of 4-morpholinethiosemicarbazide with 2-benzoylpyridine. The resultant solution was heated (50-55°C) and mixed continuously with a magnetic stirrer.



After cooling, small crystals appeared. They were filtered from the reaction mixture, washed with ethanol, and dried in air. Yield: 80-85%. Magnetic measurements showed that copper complexes have polynuclear structures; zinc and nickel complexes have monomeric structures. The in vitro cytotoxicity of the synthesized complexes on human promyelocytic leukemia cells (HL-60) was determined by a MTS-based assay. The synthesized complexes selectively inhibit the growth and proliferation of human promyelocytic leukemia HL-60 cells in the concentration range  $10^{-5}$ - $10^{-7}$  mol/L. The copper complexes have high cytotoxic activity. The nickel complexes have the lowest activity. The synthesized compounds also manifest antioxidant activity. The  $IC_{50}$  for copper complex is 90  $\mu$ M and for nickel complex is 17  $\mu$ M.

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