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Synthesis and Characterization of Mixed ligand complexes of Bipyridyl and Glycine with Different Counter Anions as Functional Antioxidant Enzyme Mimics

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Abstract : A series of mixed ligand complexes, viz., [Cu(BPy)(Gly)X]Y {X = Cl (1), Y = 0; X = 0, Y = ClO4- (2); X = H2O, Y = NO3- (3); X = H2O, Y = CH3COO- (4); and [Cu(BPy)(Gly)-(H2O)]2(SO4) (5) have been synthesized. Their structures and properties were characterized by elemental analysis, thermal analaysis, IR, UV–vis, and ESR spectroscopy, as well as electrochemical measurements including cyclic voltammetry, electrical molar conductivity, and magnetic moment measurements. Complexes 1 and 2 formed slightly distorted square-pyramidal coordination geometries of CuN3OCl and CuN3O2, respectively in which the N,O-donor glycine and N,N-donor bipyridyl bind at the basal plane with chloride ion or water as the axial ligand. Complex 3 shows square planar CuN3O coordination geometry, which exhibits chemically significant hydrogen bonding interactions besides showing coordination polymer formation. The superoxide dismutase and catalase-like activities of all complexes were tested and were found to be promising candidates as durable electron-transfer catalyst being close to the efficiency of the mimicking enzymes displaying either catalase or tyrosinase activity to serve for complete reactive oxygen species (ROS) detoxification, both with respect to superoxide radicals and related peroxides. The DNA binding interaction with super coiled pGEM-T plasmid DNA was investigated by using spectral (absorption and emission) titration and electrochemical techniques. The results revealed that DNA intercalate with complexes 1 and 2 through the groove binding mode. The calculated intrinsic binding constant (Kb) of 1 and 2 were 4.71 and 2.429 × 105 M−1, respectively. Gel electrophoresis study reveals the fact that both complexes cleave super coiled pGEM-T plasmid DNA to nicked and linear forms in the absence of any additives. On the other hand, the interaction of both complexes with DNA, the quasi-reversible CuII/CuI redox couple slightly improves its reversibility with considerable decrease in current intensity. All the experimental results indicate that the bipyridyl mixed copper(II) complex (1) intercalate more effectively into the DNA base pairs.

Keywords : enzyme mimics, mixed ligand complexes, X-ray structures, antioxidant, DNA-binding, DNA cleavage
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