^{1}H NMR Studies of Nickel(II) Complexes Bound to Oligonucleotides: A Novel Technique for Distinguishing the Binding Locations of Metal Complexes in DNA

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Abstract:

The selective paramagnetic relaxation of oligonucleotide proton resonances of d(GTCGAC)$_2$ and d(GT*GC*AC)$_2$ by Ni(phen)$_2$(L)$^{2+}$ where L = dipyridophenazine (dppz), dipyrido[3,2-d:2',3'-f]quinoxaline (dpq), and phenanthrenequinone (phi) has been examined to obtain structural insight into the noncovalent binding of these metal complexes to DNA. In the oligonucleotide d(GTCGAC)$_2$, preferential broadening of the G1H8, G4H8, T2H6, and C3H6 proton resonances was observed with Ni(phen)$_2$(dppz)$^{2+}$, Ni(phen)$_2$(dpq)$^{2+}$, and Ni(phen)$_2$(phi)$^{2+}$. In the case of the sequence d(GT*GC*AC)$_2$, where the central two bases are juxtaposed from the previous one, preferential broadening was observed instead for the A5H2 proton resonance. Thus, a subtle change in the sequence of the oligonucleotide can cause significant change in the binding location of the metal complex in the oligonucleotide. Owing to comparable changes for all metal complexes and sequences in broadening of the thymine methyl proton resonances, we attribute the switch in preferential broadening to a change in site location within the oligomer rather than to an alteration of groove location. Therefore, even for DNA-binding complexes of low sequence-specificity, distinct variations in binding as a function of sequence are apparent.