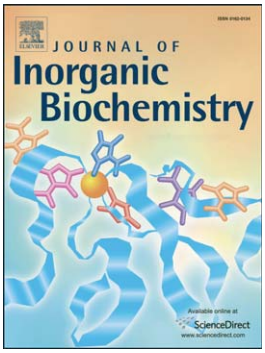

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Volumetric analysis of formation of the complex of G-quadruplex DNA with hemin using high pressure

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ABSTRACT

DNA guanine-quadruplexes (G-quadruplexes) complexed with the Fe-containing porphyrin, hemin (iron(III)-protoporphyrin IX), can catalyze oxidation reactions. This so-called DNAzyme has been widely used in the field of DNA nanotechnology. To improve DNAzyme properties, we sought to elucidate the interaction mechanism between G-quadruplex DNA and hemin. Here, we performed volumetric analyses of formation of the complex between an oligonucleotide with the sequence of human telomeric DNA (h-telo) and hemin. The G-quadruplex DNA alone and the G-quadruplex DNA-hemin complex were destabilized with increasing pressure in Na^+ buffer. The pressure required to destabilize the h-telo-hemin complex was less in K^+-containing buffer than in buffer with Na^+, which indicates that there was a smaller volumetric change upon h-telo formation in K^+ buffer than in Na^+ buffer. The calculated change in h-telo-hemin binding volume (ΔV_b) in the Na^+ buffer was 2.5 mL mol^{-1}, whereas it was -41.7 in mL mol^{-1} the K^+ buffer. The DNAzyme activity in the K^+ buffer was higher than that in the Na^+ buffer at atmospheric pressure. Interestingly, the pressure effect on the destabilization of the h-telo-hemin complex in the presence of poly(ethylene glycol)200