Abstract

The thesis is focused on the synthesis and characterization of novel Mn^{2+} complexes as alternative to Gd^{3+} chelates which are wide-spread contrast agents in Magnetic Resonance Imaging (MRI). In the perspective to find suitable chelators of Mn^{2+}, three groups of pentadentate ligands with different size of macrocylic cavity, different donor atoms and number of pendant arms containing various functional groups have been investigated. Coordination numbers of 6 or 7 were found in the crystal structure of the Mn^{2+} complexes enabling binding of one or two water molecules in the first coordination sphere. The direct water coordination causes a decrease in the complex stability and thus, the thermodynamic stability of investigated chelates is lower than that of polyaminocarboxylate complexes and their dissociation is very fast in comparison to [Mn(nota)] and $[Mn(dota)]^{2-}$. The studied Mn^{2+} complexes do not undergo oxidation in air except for complexes with 12-membered ligands which are oxidized to Mn^{3+} species. The proton relaxivities of the bishydrated complexes are two times higher than those for monohydrated complexes and are comparable to those of commercial contrast agents based on Gd^{3+} complexes. Variable-temperature ^{17}O NMR data revealed that the water exchange varies from slow to intermediate or to extremely fast, depending on the ligand. High-pressure ^{17}O NMR measurements confirmed dissociative water exchange mechanism on complexes with CN = 7 and associative mechanism on complexes with CN = 6. Small endogenous bidentate anions (phosphate, citrate) are capable of replacing only one water molecule in the bishydrated complex with the 15-membered pentaaza ligand ($\mathbf{L^2}$), while in other cases the complex is slowly decomposed or no influence is observed.

Keywords:

Manganese(II) complexes, polyaza macrocycles, pyridine macrocycles, crystal structures, stability constants, dissociation kinetics, relaxometry, high-pressure ^{17}O NMR, NMRD, water exchange, Magnetic Resonance Imaging.