Field dependence of T1 for hyperpolarized [1-13C]pyruvate

Field dependence of T1 for hyperpolarized [1-13C]pyruvate

In vivo metabolism of hyperpolarized pyruvate has been demonstrated to be an important probe of cellular glycolysis in diseases such as cancer. The usefulness of hyperpolarized 13C imaging is dependent on the relaxation rates of the 13C-enriched substrates, which in turn depend on chemical conformation and properties of the dissolution media such as buffer composition, solution pH, temperature and magnetic field. We have measured the magnetic field dependence of the spin–lattice relaxation time of hyperpolarized [1-13C]pyruvate using field-cycled relaxometry. [1-13C]pyruvate was hyperpolarized using dynamic nuclear polarization and then rapidly thawed and dissolved in a buffered solution to a concentration of 80 mmol·l⁻¹ and a pH of ~7.8. The hyperpolarized liquid was transferred within 8 s to a fast field-cycling relaxometer with a probe tuned for detection of 13C at a field strength of ~0.75 T. The magnetic field of the relaxometer was rapidly varied between relaxation and acquisition fields where the sample magnetization was periodically measured using a small flip angle. Data were recorded for relaxation fields varying between 0.237 mT and 0.705 T to map the T1 dispersion of the C-1 of pyruvate. Using similar methods, we also determined the relaxivity of the triarylmethyl radical (OX063; used for dynamic nuclear polarization) on the C-1 of pyruvate at field strengths of 0.001, 0.01, 0.1 and 0.5 T using 0.075, 1.0 and 2.0 mmol·l⁻¹ concentrations of OX063 in the hyperpolarized pyruvate solution.