

^1H NMR T_1 relaxation times of the neurochemical profiles in rat brain at 14.1T

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Introduction:

Knowledge of T_1 can be important for accurate relative and absolute quantification of brain metabolites when the repetition time is on the order of T_1 , such as in quantitative CSI (1, 2). T_1 relaxation times have been measured at 9.4 and 11.7T (2, 3) for proton metabolites and a general trend towards increased T_1 has been noted with increasing B_0 . The aim of the present study was to measure *in vivo* T_1 relaxation times of the neurochemical profiles at 14.1T in rat brain.

Methods:

Experimental: ^1H spectra were measured in 6 adult rats (Sprague-Dawley, $\text{VOI}=3\times 4\times 5\text{mm}^3$ including frontal cortex, corpus callosum and striatum). All data were acquired on a 14.1T/26cm system (Varian/Magnex Scientific) using a home-built 14 mm quadrature coil as RF transceiver, and the SPECIAL spectroscopy sequence (160 averages) (4). Field homogeneity was adjusted using FASTMAP (5). T_1 measurements were accomplished using a progressive saturation technique (by increasing TR from 1-10s, 9 measurements, $\text{TE}=2.8\text{ms}$), which was validated with an adiabatic inversion recovery measurement ($\text{TI}=0.1\text{-}1.8\text{s}$ and one fully relaxed measurement to obtain the Meq values, $\text{TE}=20\text{ms}$) for selected metabolites (Figure 1).

Data analysis: The progressive saturation series were analyzed using the LCModel software (6), combined with a simulated basis-set of metabolites containing the spectrum of macromolecules measured *in vivo* using an inversion recovery technique. The IR measurement was evaluated for the resonances labeled on Figure 1 using jMru software (7). The T_1 relaxation curves were fitted with two-parameter single exponential functions, fitting the Mo and T_1 for the IR series and Meq and T_1 for the progressive saturation series. To assess the quality of the T_1 fits, the correlation coefficients were also calculated.

Results and Discussions:

The T_1 of 16 metabolites were estimated in the rat brain at 14.1T using the progressive saturation technique and LCModel (mean \pm SD in Figure 2). The correlation coefficients of the fittings were 0.91-0.99 and the T_1 relaxation times obtained with the two approaches were the same within 15%. The T_1 were found in a relatively narrow range from 1.4s to 1.9s for all metabolites, except for Tau (2.6s). The methylene resonances of NAA and Cr+PCr had lower T_1 than their corresponding methyl resonances and similar to that of Cho. The macromolecules had the lowest T_1 ($0.66\pm 0.07\text{s}$). These results indicate that at 14.1T the T_1 relaxation time corrections are likely to be similar when using rapid pulsing conditions, which will bring a benefit for the CSI. The T_1 measured at 14.1 T is similar ($\sim 10\%$) to those measured at 9.4 and 11.7T (2, 3) suggesting that for metabolites, T_1 increases are of minimal consequence beyond 9.4 Tesla.

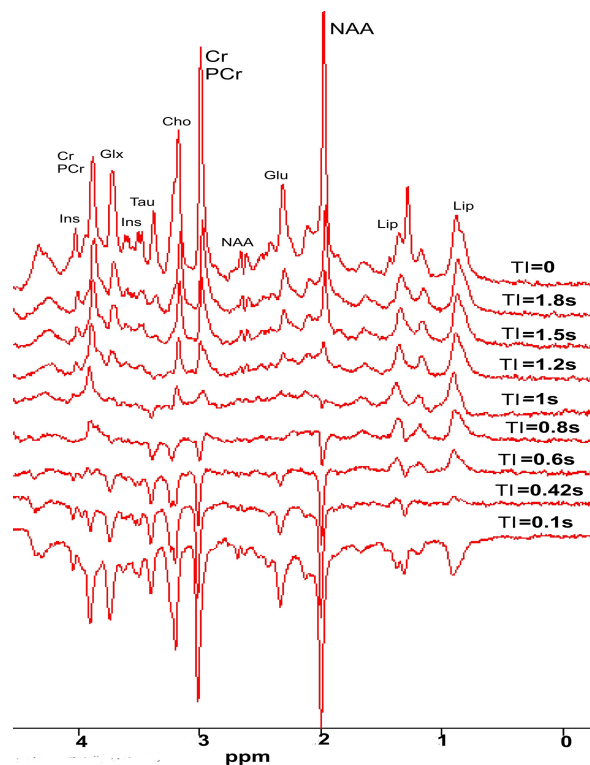


Figure 1: One series of *in vivo* spectra acquired at 14.1T in the rat brain ($\text{VOI}=3\times 4\times 5\text{mm}^3$) using the SPECIAL sequence (160 averages) with different inversion times (TI), ranging from 0 to 1.8s and a $\text{TE}=20\text{ms}$.

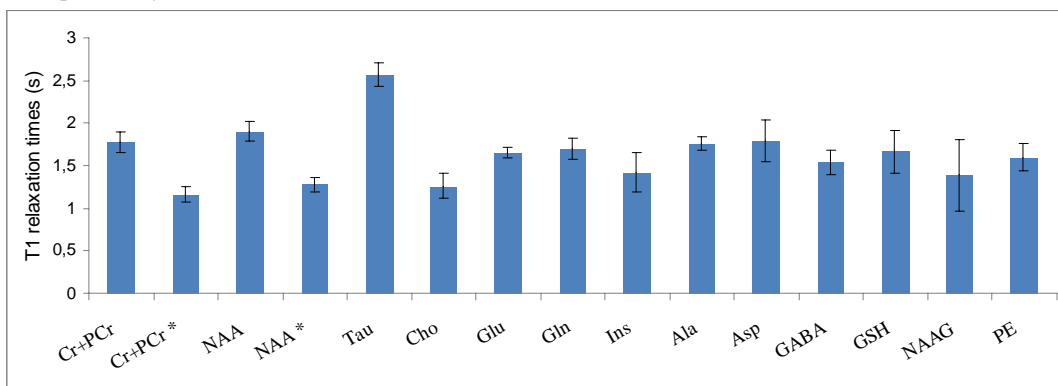


Figure 2: T_1 relaxation times (mean \pm SD) of 16 metabolites estimated at 14.1T in the rat brain using the progressive saturation technique. * Methylene resonances

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