Development of a an Improved Rat Brain Phantom for MRI studies

Collins, J.H.P., Downes, D.P., Nyguyen, T., Long, J.R. (UF, Biochemistry & Molecular Biology)

Introduction

In order to test the quantification of existing of existing MR techniques, and develop new ones, high quality phantoms are required. For this work we are focusing on mimicking the composition of low molecular weight metabolites found in rat brains. Traditionally, a solution of metabolites known was developed by GE to mimic human brain metabolites, but as seen in **Fig.1**, does not well represent that seen in rat brains. To this end an improved formulation, 'Braino 2.0' was developed. *In-vivo* spectroscopy and HR-MAS spectra of extracted tissue samples show significantly broader lines that those observed in a simple water based phantom. To this end, gelling agents to thicken the solution were also examined, and produce the more characteristic line widths seen in actual brain tissue. An existing 3D model of a rat head acquired from an MRI scan was also modified to act as a potential phantom.

Experimental

Brain tissue from a rat brain had previously been lyophilized and undergone a polar extraction to obtain a solution of small metabolites in the brain (ref). 1H spectra of these extracts were analyzed, and the concentrations of the major metabolites calculated. Varying concentrations of Sodium Alginate were added to a braino solution, and 1H spectra acquired to examine its effect on linewidth. Spectra of the various lipid substitutes were acquired, as well as stability experiments based on UV spectroscopy of their mixtures. Experiments were conducted at AMRIS, UF on the AVIII 500 and AVIII 600 NMR spectrometers.

Results and Discussion

The developed recipe for Braino 2.0 contains 12 metabolites compared to Braino's 8, and better mimics the spectra obtained from the polar extract (**Fig.1**). Testing on the sodium alginate showed it to be an effective line broadening agent, with no significant spectral overlap with the small metabolites of interest.

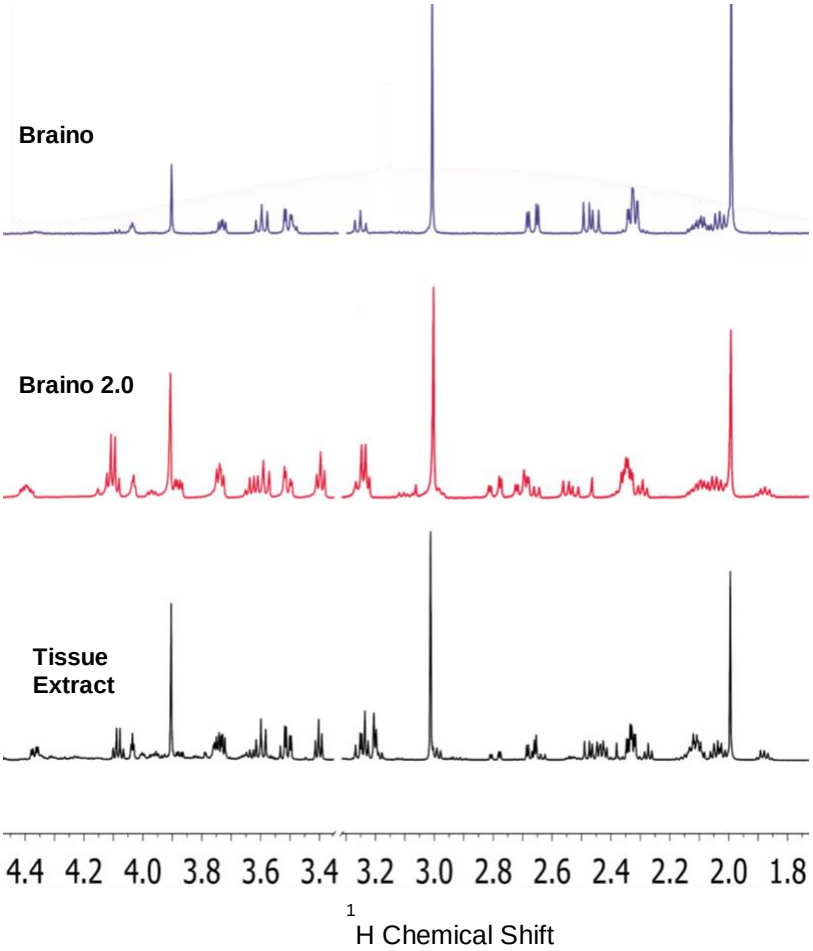

Fig.1 Comparison of Braino, Braino 2.0, and Tissue Extract

Conclusions

An improved Braino 2.0 recipe was developed, and an effective line broadening agent found. A 3D printed rat-head phantom filled with Braino 2.0, and a thin layer of Petroleum Jelly to act as a lipid substitute was produced. Further work is ongoing on refining the Braino mixture, to contain approximately 30 metabolites.

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References

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