Toward Mapping Physiological Levels of Glucose and Amino Acids *in vivo*

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Research Question

- Motivation**:** The ability to monitor and diagnose patients through various imaging techniques is a considerable opportunity for physicians and scientists. One interesting idea is to develop a glucose-sensitive imaging technique to monitor if a tumor is growing or not.
- Research Question**:** Can Deuterium Metabolic Imaging (DMI) detect glucose at physiological levels using NMR Spectroscopy in vitro?
- Project Goals:
    i. Gain expertise and background knowledge through a deep literature review.
    ii. Determine if glucose can be mapped at physiological levels.

Background

- In a recent study, deuterated glucose was administered noninvasively to rats, metabolic maps of high spatiotemporal resolution were generated
    - Clear differences in metabolism of [6,6′2H2]glucose and [2H3]acetate between normal brain and tumor tissue in a rat glioma model were shown [1]
- A technique called GlucoCEST found they could successfully map the metabolism of unlabeled glucose in vitro with concentrations between 5 mM and 10 mM using MRI [2]
- Another processes for imaging called STRIDE used Raman Scattering imaging to map carbon-deuterium bonds at a detection limit of 10 mM [3]

Experimental Design

Treat and Prepare NMR tubes
Vary concentrations of [6,6′-2H2]glucose and L-methionine-methyl-D3 from 100 uM to 5mM (5 samples per concentration and 5 concentrations per molecule).

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Imaging Tests
Scan NMR tubes at 200 MHz (4.7T) at the ASU Center for Magnetic Resonance Research.

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Post-test Analyses
Using Bayesian Probability-based software we will determine the lowest detectable concentration.

Future Direction

- The next step is to perform NMR spectroscopy on NMR tubes with of [6,6′-2H2]glucose and L-methionine-methyl-D3 at varying concentrations. This will allow us to determine at what concentrations we can successfully map glucose in vivo.
- We can then move toward mapping other substrates that tumors depend on for growth such as fructose, calcium and/or pyruvate.
- Finally, we will move toward in *vivo* testing to find the most efficient and effective substrate to test for tumor malignancy.

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