Magnetic Resonance Imaging as a Potential Tool to Image Worms in Native Environments

H. Cornnell (UF, BME); M. Stadler (UF, Biochemistry); A.K. Brasher (UF, Biochemistry); R. Ajredini (UF, Biochemistry); G. A. Walter (UF, Physiology); M. deBono (MRC, Cambridge UK); A. S. Edison (UF, Biochemistry)

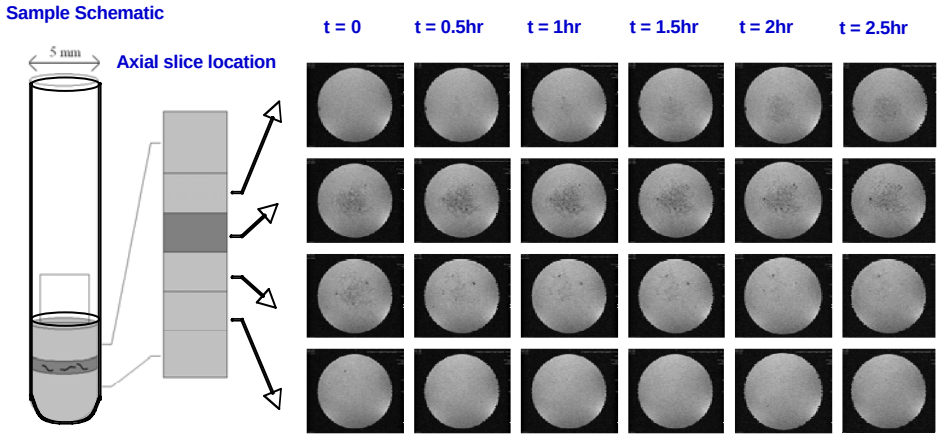
Introduction

C. elegans is one of the best studied model laboratory organisms in the word. Somewhat ironically, it is also among the least understood animals in its native environment. Despite the fact that *C. elegans* and related nematodes are wide spread in nature, nobody has been able to visualize them in their natural context. If a method were available to easily visualize nematodes in three dimensions, much could be learned about the worm's ecology. Phenomena such as aerotaxis, chemical communication, aggregation behavior, choice of food, and avoidance of noxious material could be studied in a realistic and controlled environment with a suitable 3D imaging technique.

Magnetic Resonance Imaging (MRI) has the potential for 3D worm imaging in decaying organic matter. We are investigating different ways of using MRI to image worms moving in simple substrates. We have utilized 4 different magnetic fields—4.7 T, 11.1 T, 14.1 T, and 17.6 T—at the University of Florida Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) facility and the National High Magnetic Field Laboratory (NHMLF). Each different system has advantages and disadvantages and different sample size requirements. The major issue to contend with is the trade-off between resolution, dynamics of moving worms, and signal-to-noise. High-resolution datasets (~10-50 microns) are possible with fixed samples and long measurement times (hours). However, in order to be able to monitor the movement of worms, the resolution needs to be decreased in order to capture worm movement.

Experimental

Imaging phantoms were created using a 1% low melting point agarose solution with a 2mM concentration of Gd DTPA (a common medical Gadolinium contrast agent). Layers of the agarose solution were poured into a 5mm NMR tube, and allowed to cool. *E coli* HB101 and worms were placed on the first layer of agarose. A second layer of agarose was poured on top of the worms to complete the phantom. All imaging results were obtained on a 14.6 T Bruker magnet, using a multi spin multi echo pulse sequences (12 axial slices, TR= 314ms, TE=10ms). A chemical attractant was added to the top of the agarose plug, and the mass of worms gradually migrated towards the attractant.



Conclusions

We were able to observe the movement of a large number of worms in agarose, but efforts in the natural soil environment have so far failed.

This work was presented as a poster at the 2007 International C. elegans meeting at UCLA. Support was provided through the Human Frontiers Science Program and the University of Florida University Scholars award to Alex Brasher.