2.35 T Magnetic Resonance Imaging Microscopy: Material Science and Bio-Medical Applications

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2.35 T MRI Scanner

Our 2.35 Tesla Bruker BioSpec Scanner is equipped with a transmit-only birdcage RF coil and a receive-only surface RF coil tuned to the proton (1H) NMR signal (Fig. 1). Standard 2D-FT pulse sequence allows high-resolution (45 µm/pixel) 1H images to be obtained (FOV=30mm; thickness=400µm) of phantoms and biological specimens (Fig. 1).

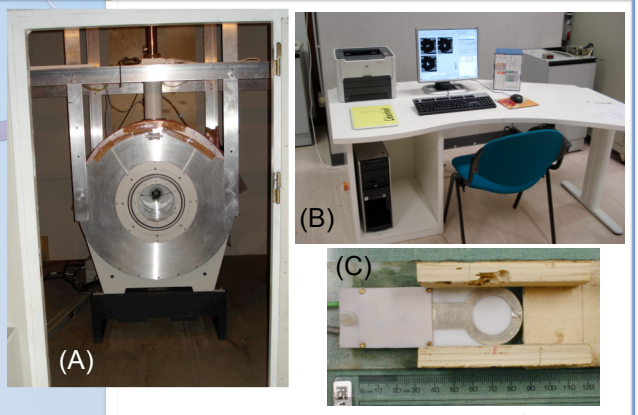

Fig. 1 (A) 2.35 T superconducting Bruker magnet (25 cm free bore). (B) Paravision 4.0 console. (C) Proton receive-only RF surface coil (20 mm diameter).

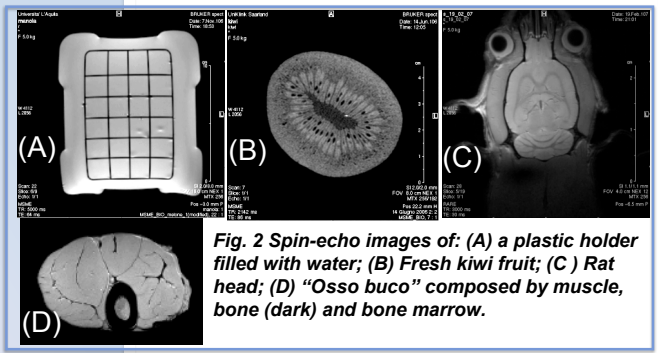

Fig. 2 Spin-echo images of: (A) a plastic holder filled with water; (B) Fresh kiwi fruit; (C) Rat head; (D) "Osso buco" composed by muscle, bone (dark) and bone marrow.

Material Sciences

(prof. L. A. Pajewski, Dip. CICM, L'Aquila)

Alginate gel beads are used in material science, food industry, pharmacology, medicine and their properties depend on many parameters, including origin and purity of the alginate, fabrication method, bead size, gelling ion composition [1-2]. We have developed high resolution (~ 100 µm) 2.35 Tesla MRI to characterize the microscopic structure, Fig. 3, of calcium alginate beads suitable for biomedical applications [3].

[1] Manz et al, Eur Biophys J. 33:50–58 (2004).
[2] Zimmermann H, et al, Appl Phys-A 89:909-922 (2007).
[3] M. Bascelli, L.A. Pajewski, A. Fracassi, A Sotgiu, M. Alecci, *Proc. ESMRMB* pg. 307-308 (2008).

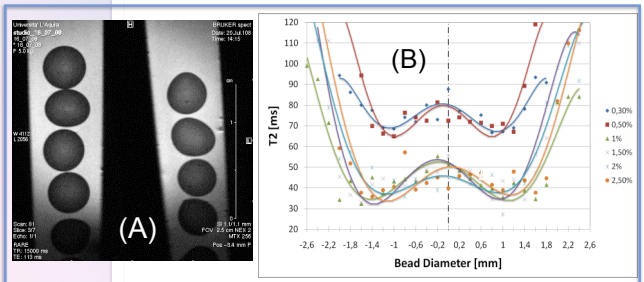

Fig. 3 (A) **Coronal RARE images (TR=15s; TE=50 ms) of alginate beads at 2.5 % (left) and 2 % (right). (B) T2 relaxation time along the bead diameter for various initial alginate concentrations (0.3-2.5%).**

Neuro-Sciences: Hemi-Parkinson's Rat Models

(Dr.ssa T. Florio, Dip. STB, L'Aquila)

Parkinson's Disease (PD) is a progressive neuro-degenerative disorder characterized by the degeneration of dopaminergic neurons in the substantia nigra pars compacta, producing a cascade of functional changes affecting the basal ganglia network [1]. The unilateral injection of 6-Hydroxydopamine (6-OHDA) into the striatum of rats leads to the retrograde degeneration of the dopaminergic nigrostriatal tract [1]. Location and size of the lesion before and after treatment are usually measured histologically, requiring the sacrifice of the rats. We have developed high-resolution MRI (90 µm) and immuno-staining to caracheterize hemi-PD rat models (Fig. 4) and to relate these to behavioural performance [2].

[1] Kondoh et al, Experimental Neurology 192:194 (2005).
[2] G. Confalone, D. Minchella, T. Florio, E. Scarnati, A. Sotgiu, M. Alecci, Proc. ISMRM (2009), submitted.

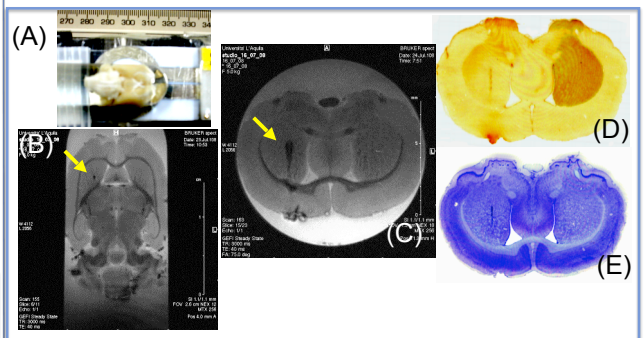

Fig. 4. (A) Rat brain under formaline ready for high-resolution MRI; Coronal (B) and Axial (C) RARE images (TR=15s; TE=50 ms; thickness =1mm) of rat brain after intrastriatal 6-OHDA injection (arrow); TH+ (D) and CV (E) histology of the MR image in (C).

MRI/MRS and the Biology of Human Gliomas

(prof.ssa A. Cimini, Dip. BBA, L'Aquila)

Gliomas are histologically graded by cellularity, cytological atypia, necrosis, mitotic figures, and vascular proliferation, features associated with biologically aggressive behaviour. Recently, it has been reported that human gliomas accumulates lipid droplets during progression, suggesting a lipid metabolism impairment [1]. We are using MRI/MRS to detect lipids signal (Fig. 5) in human glioma tissues [2].

[1] Opstad, KS, et al, NMR Biomed. 2008; 21: 677–685.
[2] B. D'Angelo, E. Benedetti, G. Laurenti, R. Galzio, G. Cifone, A. Sotgiu, M. Alecci, A. Cimini, Lipids detection in human gliomas, II Mini-Workshop MRI in L'Aquila and Juelich, October 18th, L'Aquila (2008).

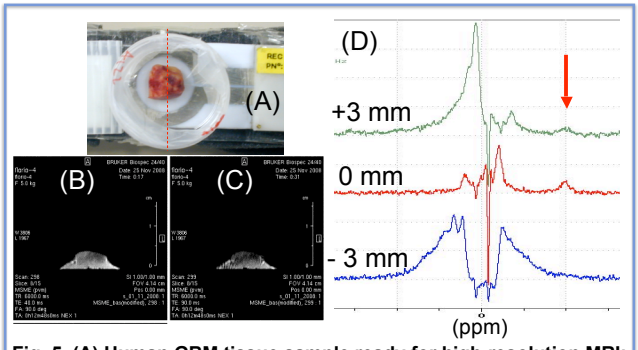

Fig. 5. (A) Human GBM tissue sample ready for high-resolution MRI; Axial MSME images (TR=6s; thickness =1mm) obtained at TE=40 ms (B) and TE=90 ms (C); (D) Water suppressed PRESS spectra (TR=6s, TE=20 ms) from a cubic vovel (3mm) at 3 different positions within the tissue. The lipid peak is shown by the arrow.