Anti-atherogeneicity of Flaxseed: High Field MRI of Plaque Deposition and Regression

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Introduction
Atherosclerosis has been implicated in high incidents of myocardial infarction and stroke, especially in the estrogen deficient postmenopausal woman, due to accumulation of plaque that reduces luminal area and restricts blood flow to vital organs like the heart and brain. Although hormone replacement therapy (HRT) has been shown to improve lipid profile and relieve symptoms associated with menopause, its cardiovascular benefits have come under recent scrutiny. Current studies have shown no benefit or even an increased rate of CVD events among women receiving HRT. Many women are looking for non-pharmacological means of reducing cholesterol, atherosclerotic lesion formation and CVD risk. In recent years, the use of functional foods has received considerable attention for reducing CVD risks. Among functional foods that have been examined for their anti-atherogenic properties flaxseed is very promising in terms of atherosclerotic lesion regression. In this newly initiated study, flaxseed diets of varying concentrations (7.5, 15 and 22.5%) are being compared to estrogen replacement in an ovariectomized (Ovx) hamster model to assess atherosclerotic lesion regression. High field MRI scans conducted at 21.1 T will be used to monitor plaque development and treatment efficacy.

Experimental
This study recently has been initiated with in vivo baseline scans of 36 golden Syrian hamsters (Mesocricetus auratus). Hamsters with lesions will be evaluated three times during the study (baseline, 4 months, 8 months). Baseline scans were conducted within a week of Ovx. Using a 35-mm birdcage coil and modular probe designed in-house at the NHMFL, high resolution MRI scans were acquired using 2D multislice fast spin echo (FSE) sequences. Imaging was performed on the thoracic vasculature and included visualization of the CNS. In a 13-minute acquisition, coronal images of the hamster were obtained at a resolution of 133x133x500 μm (Fig 1); subsequent images in an axial plane were acquired at a resolution of 195x125x1000 μm in 5 minutes (Fig 2). Excellent contrast of the neuroanatomy (particularly neurovascular structures) was obtained during these initial imaging sessions.

Results and Discussion
Our rationale for utilizing MRI to view the vasculature is to track lesion development and regression on an individual animal basis. Atherosclerotic progression will be evaluated again at 4 months to assess the extent of lesion formation and plaque distribution prior to the experimental flaxseed intervention. A final evaluation (8 months) will be done to determine the effects of the flaxseed diets on the extent of lesion formation and plaque distribution. MR imaging will 1) prevent premature treatment of animals, 2) provide a quantitative assessment of the inner diameter of the vessels and 3) yield spatial assessment vessel architecture and potentially occlusive bodies.

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Figure 1: Coronal 2D FSE of Ovx hamsters acquired at 21.1 T. Acq time = 13 min.; Res = 133x133x500 μm

Figure 2: Axial 2D FSE of Ovx hamsters Acq time = 5 min; Res = 195x125x1000 μm