CEST-MRI to reveal new contrasts: application in preclinical imaging and food science

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Guilhem Pagès[a] and J.-M. Bonny[a]

[a)] *AgroResonance, UR370 Qualité des Produits Animaux (QuaPA), INRA, F-63122 Saint-Genès-Champanelle*

Abstract: MRI is one of the most performant non-invasive imaging technique. The images are contrasted thanks to local differences in water properties (T_1, T_2, ADC,…). One of the main limitation of MRI deals with its lack of sensitivity to image other molecules than water. One solution to circumvent this limitation is based on imaging the chemical exchange between solute (containing exchangeable protons) which is present in a too low concentration to be observable by MRI and the readily imaged water molecules. For that, several images are recorded with a signal saturation at different offsets from the water frequency. The water signal intensity is measured in function of the offset in a so-called z-spectrum. When exchangeable protons are irradiated, the water attenuation is more important than expected. The quantification of this attenuation provides an indirect way for imaging this low-concentration population.

This approach has been implemented on our high-field MR imagers and is currently used in two projects. The first one consists in evaluating CEST imaging to characterize simultaneously both hypoxia and proteoglycan concentration in an animal model of chondrosarcoma (i.e., cartilage cancer). The hypoxia (pH) is imaged from the CEST effect of the amide functions (~3-4 ppm from the water frequency) while the proteoglycan concentration is deduced from the chemical exchange between hydroxyl groups and water (~1 ppm from the water resonance). As both properties are important in this pathology, CEST-MRI presents the advantage to assess both of them within a single acquisition.

The second project focusses on imaging the gluten network formation in baking products. Indeed, the gluten network is made thanks to the formation of disulfide bonds from thiol moieties. First, we demonstrated that it is possible to monitor chemical exchange between thiol function and water. Applying CEST-MRI to baking products requires taking into account the magnetization transfer effects, which are predominant in the z-spectrum.

We will present the progress of both projects.