NMR relaxometry experiments in bovine and human cartilage - simulating the effects of osteoarthritis

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Cartilage is an essential part of the vertebrate body. It can be viewed as a fiber-reinforced, permeable composite gel within a physiological salt solution. Most of it is composed of extracellular matrix, at around 98% of volume. The major fibrous component of cartilage, type II collagen, provides the tensile strength of cartilage. Proteoglycan aggregates, which generate a high osmotic pressure in the cartilage, are found between the collagen fibers. Osteoarthritis (OA) is a disease that affects the cartilage in joints, leading to pain of increasing intensity, joint stiffness and even loss of mobility [1]. Developing a method for the early detection of OA starts with understanding the healthy tissue and the effects of various treatments on its properties, as well as the investigation of ex-vivo specimens of healthy and diseased cartilage. Low-field NMR relaxometry provides a different perspective from the clinical MRI currently in use [2]. It offers information on the molecular dynamics inside the tissue, before and after it has been subjected to various conditions, such as degradation by trypsin, which affects the capacity of cartilage to sustain pressure. In the current work, bovine articular cartilage has been used as a model tissue to reveal the influence of drying (Fig. 1a), aging and trypsin treatement on the relaxation dispersion curves. The same technique has been applied on samples extracted from patients who underwent knee replacement surgery, revealing different characteristics of the dispersion curve depending on the severity of the disease (Fig. 1b). Histology and Mankin grading of these and future samples will allow a correlation between the properties of the relaxation dispersion and the severity of the disease.

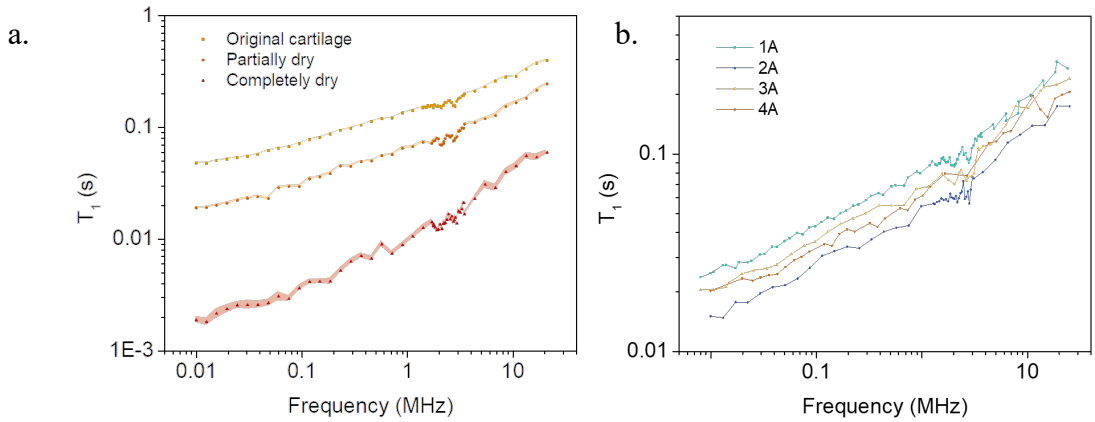

Fig. 1. a. Dispersion curves of bovine cartilage undergoing drying, ***b.*** Dispersion curves of four samples extracted from the same human joint, at different locations.

References

[1] Y. Xia, K. Momot, Biophysics and Biochemistry of Cartilage by NMR and MRI, The Royal Society of Chemistry, 2017.
[2] E. Rößler, C. Mattea, S. Stapf, S. Karhula, S. Saarakkala, M.T. Nieminen, *Microporous Mesoporous Mater.* **269** 160–165 (2018).