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Application of the FRAP technique to food matrices: migration properties of small solutes in model cheese.

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In cheese technology, the mass transfer of small solutes, such as salt, moisture and metabolites during brining and ripening, is very important for the final quality of the cheese. Numerous studies have reported the transfer of salt in cheese during brining and ripening, but very few papers have dealt with the mass transfer properties of other small solutes in cheese. Moreover, most of the reported effective diffusion coefficient values have been obtained by macroscopic and destructive concentration profile methods (Floury *et al.*, 2010).

However it is now possible to consider concentration profiles on a microscopic scale using a representative molecule, or probe molecule, which can be easily characterized using a specific technique. Using radioactively labelled or fluorescent molecules, it is then possible to measure the rate of diffusion of one component in a multicomponent system. However, these methods are still quite difficult to apply to complex matrices such as cheese.

Our objective was to develop a non-destructive technique based on the fluorescence recovery after photobleaching (FRAP) technique to determine the mass transfer properties of small solutes at a microscopic level in model cheese matrices.

These matrices were obtained from renneted concentrated low fat milk produced by ultrafiltration or microfiltration. It allowed to concentrate, either the full milk proteins, or more specifically the caseins, and then to obtain different microstructures. Gelatine or milk fat were also added to these products to modify the gel network. Structural properties of the matrices were observed by confocal microscopy and their textural properties were analysed by rheological measurements.

The FITC-Dextran 4000 probe was chosen as a model of small solute for its fluorescent properties. Migration rates of this fluorescent dye in the different model matrices were measured by performing FRAP experiments with a confocal laser scanning microscope (CSLM). Then an alternative modelling approach developed by Braga *et al.* (2004) was adapted to our measures in order to evaluate diffusion coefficients of the FITC-Dextran in each matrix. The main interest of their model is that it takes into account diffusion of the migrating molecules during the bleach phase, which was lacking in more classical models for quantitative data analysis of FRAP experiments.

References:

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- J. Braga, J.M.P. Desterro, M. Carmo-Fonseca (2004) Intracellular macromolecular mobility measured by Fluorescence Recovery after Photobleaching with Confocal Laser Scanning Microscopes. Molecular Biology of the Cell, 15, 4749-4760.