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Nisin migration is dependant on the microstructure of the cheese matrix: an *in situ* investigation

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Bacterial growth in solid or semi-solid matrices is of importance in many food systems. In cheese matrixes, bacteria grow as immobilized colonies, and the diffusion is the main mechanism for the transfer of nutrients and metabolites. Migration limitation can then act as a constraint to the bacterial growth. Very few data is available in the literature about small solute diffusion in cheeses (Floury *et al.*, 2010).

The aim of this work was to explore if nisin diffusion in cheese model is dependant on model cheese composition or not. Our strategy was to study nisin migration using a nisin producing strain (*Lactococcus lactis diacetylactis* UL719) and nisin sensitive strain (*Lactobacillus sake* ATCC 15521) in co-culture. Death rate of *Lb sake* was considered as a marker for nisin diffusion. The composition of the model cheese matrix was modified by adding different percentages of gelatin (0, 4 and 10%). *Lb sake* death kinetics was followed in the early stages of culture in model cheese.

In parallel, effective diffusion coefficients of nisin were estimated thanks to the classical concentration profile method and Fick's law second. Nisin concentration was measured by ELISA (Enzyme Linked ImmunoSorbent Assay). In addition, the structural properties of the products were observed by confocal microscopy and the textural properties of the matrices were analyzed by rheological measurements.

Increasing gelatin percentage in model cheeses caused faster death for *Lb sake*. Gelatin had changed the model cheese microstructure by forming pathways in the protein network which most likely accelerate nisin migration. Formation of these pathways was verified by using FITC-labelling of the gelatin before incorporation into the retentate. *Lc lactis* growth and its *in situ* nisin production were not affected by the addition of gelatin. Furthermore, *Lb-sake* death was not affected by (1) the acidification by *Lc lactis*, (2) the nutritional competition with *Lc lactis*, and (3) the addition of gelatin. Nisin concentrations obtained by ELISA confirmed that nisin migration was faster in matrix with 10% added gelatin.

Such a dynamic investigation of nisin migration was achieved for the first time in cheese matrix. Nisin diffusion in cheese matrix could be modified by changing the cheese composition, which also affects the cheese structure. As a peptide, nisin could be a model of peptides obtained from the proteolysis during cheese ripening.

References:

J. Floury, S. Jeanson, S. Aly, S. Lortal (2010) Determination of diffusion coefficients of small solutes in cheese: a review. Dairy Science and Technology. DOI: 10.1051/dst/2010011.