IUFoST 2006
DOI: 10.1051/IUFoST:20060418

IUFOST2006/418
Study of cream cheese microstructure by confocal laser scanning microscopy : quantitative image analysis

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As texture is a major quality requirement for cream cheeses, its control is a recurring problem for manufacturers. A better knowledge of the structure of these products would help its optimization. Confocal laser scanning microscopy (CLSM) is a useful technique for studying the microstructure of a wide variety of foods, in particular weak dairy gels such as cream cheeses, since they do not suffer physical disruption.
In the case of cream cheeses, a multiple fluorescent labelling of proteins and lipids has been developped to observe the emulsion gel network. A qualitative analysis of these photographs is sufficient for structure description, but it may not be satisfactory for an objective comparison between two pictures. Yet, in order to ascertain the structural differences responsible for texture variations, it is necessary to quantify and to compare the differences between the photographs of two different cream cheeses and between two pictures of one cream cheese.
In this study, several image analysis methods were applied in order to evaluate their capability for discriminating the photographs according to the classes of cream cheeses they belong to. These methods can be sorted in three groups : fractal study, texture analysis and mathematical morphology. The determination of the fractal dimension of the gels by applying a size-varying box count does not provide satisfactory results, though it does not discriminate the different classes of products. Texture analysis methods include co-occurrence matrices, autoregressive model, wavelet decomposition and run length matrices. They are quite efficient to discriminate the cream cheese photographs, and even more if they are applied simultaneously, but the features they provide cannot be easily understood on a physical and structural point of view. Mathematical morphology results are both discriminating and directly interpretable.
Whatever the method chosen, the numbers of features required to describe an image implies to use multivariate statistical methods (PCA, PLS, discriminant analysis) to detect the significant ones, and to allow a physical interpretation.