Lorenzo Fongaro: Assessment of the surface aspect of foods using ImageJ plugins

Abstract

Surface aspect, also called surface texture, is an important characteristic of foods as well as color, shape, consistency and taste. The external surface of a food is the place where the consumer takes contact the first time through sight, and it is the site where the chemical and physical changes occur early on. It thus plays an important role in consumers decision and it can affect the properties of a product during its preparation, storage and consumption. In addition, the surface aspect of a food product also depends on the quality of the raw materials and on the condition used for its production. This work shows the ability of different image analysis techniques to characterize the surface texture of two cereal derivatives, corn flakes (3 commercial samples, coded C1, C2 and C3) and plum cakes (5 experimental samples, coded A, B, C, D and E). In particular, two ImageJ texture plugins were used: the Grey Level Co-occurrence Matrix (GLCM) and the Angle Measure Technique (AMT). Datasets consisting of 90 and 60 images, for corn flakes and plum cakes respectively, were analyzed. A quantitative analysis of the GLCM by means of various descriptors was used to characterize the surface texture of the different samples, and significant differences ($p<0.05$) were highlighted among the samples, both within the corn flakes and plum cakes group. Applying the principal component analysis (PCA), followed by the partial least square discriminant analysis (PLS-DA) on the AMT spectra obtained from each image dataset, it was possible to find the best samples class modeling only as a function of the surface texture features (sensitivity>0.83; specificity>0.69). The interesting results obtained in this research showed the high potential of these ImageJ texture plugins in the evaluation of the surface properties of foods. As the surface texture depends on many factors and can influence many other properties of foods, this is an important point, especially in order to predict some phenomena related to changes in formulations or process conditions.

Keywords

foods, image analysis, surface texture, GLCM, ATM

Short CV

Mr. Lorenzo Fongaro is currently responsible for Image Analysis Laboratory of Food Technology Unit at the Department of Food, Environmental and Nutritional Sciences of University of Milan. Since 1999 he has acquired experience in micro and macrostructure characterization of foods by means of rheological, mechanical and image analysis techniques. He uses image analysis for the morphologic and densitometric characterization of foods and he applies image texture analysis and multivariate image analysis for surface characterization of foods. Currently, one of the interests of the Food Technology Unit is the evaluation, by means of different image analysis techniques, of the micro and macro structural changes of foods associated to the different raw materials and technologies adopted.

Administrative data

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