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Spectroscopic Analysis of Browning Reaction in Food

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The browning reaction in food is one of the most important reactions which dramatically affects its chemical and physical properties. This study was conducted in two parts: the first part addresses non-enzymatic browning by the Maillard reaction, and the second part addresses enzymatic browning of apples. Previously, there have been difficulties in analyzing and characterizing products of the Maillard reaction. A multivariate curve (MCR) resolution method, as part of a multivariate analysis, and a partial least square regression (PLSR) were applied to the ultraviolet-visible (UV-VIS) and visible-near infrared (VIS-NIR) spectroscopic data derived from the analysis of two aqueous model Maillard reactions, namely glucose-glycine (GG) and glucose-lysine (GL). The components calculated by MCR reflect the product at each reaction stage. Fluorescence spectral data (excitation-emission matrix) were decomposed using PARAFAC, a multiway method of MCR for 3D data. The results demonstrated that three components are embedded in the fluorophore spectra. Furthermore, the score data from both the MCR and PARAFAC were applied with a first order kinetic reaction model to investigate the reaction rate. All data showed that the kinetic constant for the formation of products in GL was higher than that in GG. Enzymatic browning of apples was investigated using visible-near infrared (VIS-NIR) spectroscopy and hyperspectral imaging. From a principal component analysis (PCA) of the hyperspectral image of the surface of the sliced apple, the difference between a part treated with ascorbic acid and ultrasonic waves to suppress the browning and a part exposed to the atmosphere could be easily discriminated. Overall, spectroscopic techniques coupled with multivariate analyses have a strong potential to analyze both non-enzymatic and enzymatic browning reactions.