Use of near-infrared hyperspectral (NIR-HS) imaging to visualize and model the maturity of long-ripened hard cheeses

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Spectroscopic measurements and imaging have great potential in rapid prediction of cheese maturity, replacing existing subjective evaluation techniques. In this study, 209 long-ripened hard cheeses were evaluated using a hyperspectral camera and in a parallel sensorial evaluation by a tasting panel. A total of 425 NIR hyperspectral (NIR-HS) images were obtained at 14, 16, 18, and 20 months of ripening, until final sensorial approval of the cheese. The spectral data was interpreted as possible compositional changes between maturity levels. Regression modeling by partial least squares (PLS) was used to explain the relationship between average spectra and cheese maturity. The PLS model was evaluated with whole cheeses (average spectrum), but also pixelwise, producing prediction images. Analysis of the images showed maturation and increasing homogeneity of the cheese over time. It also suggested that maturation begins at the core and spreads to the outer periphery of the cheese.

Key words: Cheese maturation; Principal component analysis; Partial least squares regression; Pixelwise image prediction

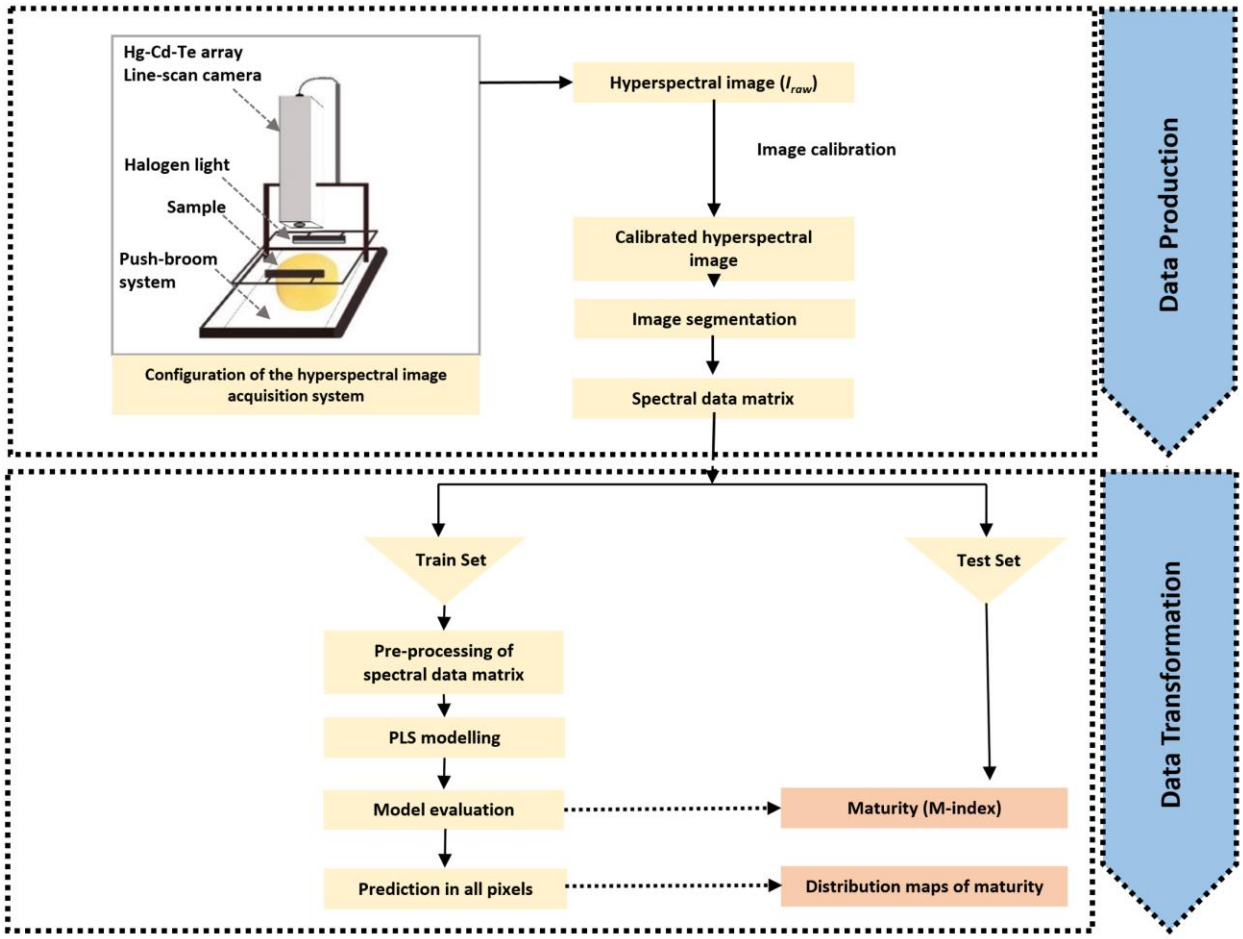

Figure 1. Flow chart of the hyperspectral imaging, pre-processing, and partial linear squares (PLS) modeling procedure used for predicting the maturity of long-ripening hard cheeses.