

# Evaluation of Machine Learning Methods for Organic Apple Authentication by Diffraction Grating and Image Processing

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**Abstract-** In this work we present an extensive evaluation of a low-cost, non-destructive sensor system on a task to differentiate between organic and conventional apples. This system includes a diffraction grating sheet, a smart phone, and a flashlight. The flashlight is used as a light source to illuminate an apple, the diffraction grating sheet splits the reflected light from the apple into different colors to create a rainbow, and the smartphone records the rainbow image. We acquired 150 apples from a local supermarket, 75 being organic and 75 being conventional. We used the sensor system to collect rainbow images under room temperature and dark condition, and then used image processing tools to convert images into spectra. We ran twelve machine learning algorithms on the spectral data created this way and conducted further experiments using a commercial NIR spectrometer on the same set of apples. The locally weighted partial least squares classification (LW-PLSC) reached the highest accuracy of 93% on rainbow image data, while the partial least squares discriminant analysis (PLS-DA) correctly classified all spectral data. The sensor system is convenient and low-cost, which provides a variable solution for in-line food authentication.