Title Feasibility of near-infrared hyperspectral imaging to differentiate Canadian wheat classes

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Abstract

Differentiation of wheat classes is one of the important challenges to the Canadian grain industry. Even though some wheat classes may look similar, their chemical composition and consequently the end-product quality can vary significantly. Visual differentiation of wheat classes suffers from disadvantages such as inconsistency, low throughput, and labour intensiveness. A near-infrared (NIR) hyperspectral imaging system was used to develop classification models to differentiate wheat classes grown in western Canada. Wheat bulk samples were scanned in the wavelength region of 960–1700 nm at 10 nm intervals using an InGaAs NIR camera. Seventy-five relative reflectance intensities were extracted from the scanned images and used for the differentiation of wheat classes using a statistical classifier and an artificial neural network (ANN) classifier. Classification accuracies were 100% in classifying Canada Prairie Spring Red (CPSR), Canada Western Red Winter (CWRW), and Canada Western Soft White Spring (CWSWS) wheat classes and >94% for the other wheat classes (Canada Western Extra Strong (CWES), Canada Western Hard White Spring (CWHWS), Canada Western Red Spring (CWRS), Canada Prairie Spring White (CPSW) and Canada Western Amber Durum (CWAD)) using Linear Discriminant Analysis (LDA) with a leave-one-out cross-validation method. In Quadratic Discriminant Analysis (QDA) with a leave-one-out cross-validation method, the classification accuracies were >86% for all wheat classes. The overall classification accuracies of 60% training–30% testing–10% validation (referred to as 60-30-10) and 70% training–20% testing–10% validation (referred to as 70-20-10) ANN models were above 90% for independent validation sets using three-layer standard and Wardnet back-propagation neural network architectures.