Hyperspectral imaging technology: An alternative method for agricultural and biosecurity diagnostics

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Abstract

Food security is of paramount importance to key stakeholders in the agribusiness sector. Over the years, quality, and safety assessments of fresh and processed horticultural products have become increasingly important with issues such as global food security, and with the advent of a global pandemic Hyperspectral imaging (HSI), originally developed for remote sensing applications, has recently emerged as an alternative analytical tool for non-destructive food analysis. Recent advances in computer technology have led to the development of imaging systems capable of identifying quality problems rapidly on the processing line, with the minimum of human intervention. This paper provides a comprehensive review on recent applications of hyperspectral imaging technology for preharvest and postharvest analysis for biosecurity diagnostics. It explores hyperspectral imaging architecture, its equipment, image acquisition and data processing. While gathering satisfactory datasets is very crucial, HS imaging tasks are still costly and time-consuming. Usually, available HS image data is not enough to train and develop classification models. Significant progress has been made in the area of developing specialized software and toolbox for such image and spectral data analysis. Machine learning algorithms have evolved and is now utilized to alleviate the bottle neck for automatic image acquisition, data dimensionality reduction and even develop classification models for early bruise/disease detection and fruit grading/sorting applications. Also, new and more straightforward data collection and manipulation methods are being proposed to help mitigate the cost and effort required for a real HSI benchmark dataset. This information is useful for those in the growers/ processing industries and food safety and quality control stakeholders.

Keywords: Biosensors; Fruit quality; Food security; Image analysis; Machine learning.