Abstract for the 10th International FRUTIC Symposium 'Quality and Safety of Fresh Horticultural commodities' 7 February 2017, Berlin, Germany, p. 53

Comparison of advanced non-destructive methods to classify healthy and diseased onions

Md. Nahidul Islam[1*], Merete Edelenbos[1]

Aarhus University, Department of Food Science, Kirstinebjergvej 10, DK-5792 Aarslev

*Email: *nahidul.islam@food.au.dk*

During cold storage, onions are lost due to loss of skin, skin cracking, sprouting, rooting, mass loss and development of diseases. Among these defects, spoilage of onions due to diseases may lead to significant losses. Different diseases exhibit different symptoms and symptoms may be visible on the outer surface or only inside. Diseases with external symptoms can be detected easily by non-destructive visual inspection and machine vision techniques. Detecting internal diseases, however, needs either destructive or advanced non-destructive techniques as the diseased part may develops in the core of the onion.

Near-Infrared (NIR) spectroscopy is a non-destructive technique, which is suitable for the analysis of product with higher water and carbohydrate contents. However, NIR spectroscopy can only measure at one point at a time. Thus, quality assessment using this technique may provide incorrect information if sampling points are too few or the area of the infected tissue is too small. Spectral Imaging, which combines machine vision and spectroscopy, overcome these limitations as both spatial and spectral information are acquired simultaneously. Commercial sorting machines are available for size and quality sorting of onions. However, it is not clear how well these machines sort onions into healthy and diseased onions and it may lead to misclassification and food losses. False positives result in sorting reduce profit of the farmer and false negative may lead to consumer dissatisfaction and rejection. The objective of this study was to compare the efficiency of Spectral Imaging and NIR spectroscopy to classify healthy and diseased onions.

Onions were sorted after six months of cold storage into healthy and diseased onions using a commercial sorting machine (Sammo, Longbardi). The sorting machine consisted of NIR spectrophotometer for internal quality measurement, a laser scattering unit for detecting volume, scale splitting, loss of scales, and external diseases, and a weighing unit for detecting foreign. From the machine-sorted onions, 15 first-class, healthy and firm onions (size 40 – 80 mm with intact outer dried scales, no visual symptoms of diseases, and a firm feeling) and 30 diseased onions (size 40 – 80 mm with intact outer dried scales and no visual symptoms of diseases) were selected. Onions were numbered, and subjected to non-destructive measurements by Multispectral Imaging using a VideometerLab (Videometer A/S, Hørsholm, Denmark), Hyperspectral Imaging using two custom built Hyperspectral Imaging systems; one at a wavelength of 419 nm to1116 nm and another at 1016 nm to1742 nm (Newtec Engineering A/S, Denmark), and Fourier Transform Near Infrared Spectroscopy using AgriQuant FT-NIR (Q-interline). All onions were visually inspected after the non-destructive measurements and the inner and outer scales were assessed for diseases after

halving the bulbs. From this assessment, only 13 out of the 30 diseased onions were rated as diseased and the number of bulbs was thus reduced to 13 to have a similar sample size.

Spectra from the non-destructive methods were pre-processed and a Partial Least Square Discriminant Analysis, (PLS-DA) classification model was built with these data. Hyperspectral Imaging at wavelengths between 1016 nm to 1742 nm showed better performance with higher sensitivity and specificity compare to the other methods. Overall, Spectral Imaging provided better classification of onions than NIR spectroscopy.