

Abstract

Detection of fruit fly larvae in intact mangoes by three-wavelength near infrared imaging

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Introduction

Fruit exported from countries considered as fruit fly habitats are often of inferior quality due to disinfection treatments such as vapour heat treatment (VHT). Consequently, the feasibility of using NIR spectroscopy and imaging to detect fruit fly infestations in intact mangoes was investigated here. Classification was based on the fact that fruit consist mainly of water and carbohydrates while insects are mainly comprised of proteins and lipids.

Materials and Methods

A spot-type portable short-wave instrument 'NIR-Gun' was used to acquire spectra of 348 mangoes, divided into control and infested sample sets. Classification was performed by PLS-Discriminant Analysis (PLS-DA) on the second derivative spectra. Next, a system equipped with the NIR camera Inspector V10E was used to acquire hyperspectral data in the same region. Sixteen mangoes were used. Eight fruit (four infested, four control) were imaged to extract 576 infested spectra and 432 control spectra which were input to an iterative Bayesian classifier (DA) to identify the best combination of three wavelengths for distinguishing infested spectra from control. A C algorithm was developed to convert the classification results from the DA function into pixel intensity values for an 8-bit gray scale image. The remaining eight fruit (four infested, four control) were used as a test set.

Results and Discussion

Classification results of 1.2% false negative (FN) were achieved using PLS-DA on spectra obtained from the spot-type instrument at 48 hours after infestation. DA of the imaging data yielded 0.9% FN using absorbances at 775, 808 and 944 nm (Larvae number: 7-61). Gray scale images based on Mahalanobis distances calculated from the three wavelengths clearly distinguished infested and control samples with few false positive results.

Conclusion

This research demonstrates the ability of NIR imaging as a basis for a low-cost high-speed online sorting device for the purpose of detecting fruit fly infested fruit.