C0392: Detection of decay in citrus fruit using absorption and scattering properties

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Introduction

 Early detection of fungal infections in citrus fruit still remains as one of the major economical problems in postharvest.

 Detection of infected fruit is performed manually by trained workers using dangerous UV lighting.

Objective

To detect decay lesions in citrus fruit by analysing the absorption ($\mu_a$) and reduced scattering ($\mu'_a$) coefficients of sound and damaged peel using laser-light backscattering imaging.

Results

 Farrell’s model described backscattering profiles accurately at the five laser wavelengths using $\mu_a$ and $\mu'_a$ ($R^2 \geq 0.982$).

 Overall accuracy reached a maximum value of 92.43% using the first eight features ranked with the MI feature selection method.

 The selected features provided good results, with a percentage of well-classified samples above 90% for both classes despite the similarity between sound and decaying skin.

Material and methods

 40 oranges cv. ‘Valencia late’ were infected with P. digitatum and stored until decay lesions had a diameter $\geq 25$ mm.

 Backscattering images of sound and decaying surface areas of each fruit were acquired using laser diode modules emitting at five wavelengths (532, 660, 785, 830 and 1060 nm).

 Images had radial symmetry with respect to the light incident point, being reduced to one-dimensional profiles after radial averaging.

 Farrell’s diffusion theory model was used to fit the profiles and to estimate $\mu_a$ and $\mu'_a$ at each wavelength, resulting in ten features characterising each skin sample.

 A feature selection method based on mutual information (MI) was used to select the most relevant coefficients for decay detection.

 The selected coefficients were used as input vector for discriminating between sound and decaying skin using a LDA classifier.

Conclusion

These results show the high potential of the laser-light backscattering imaging technique as an alternative for online detection of early decay symptoms caused by P. digitatum fungi in citrus fruit.

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