Title Modeling apple quality changes based on laser scattering image analysis under simulated shelf life conditions

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Abstract

A 650 nm, 25 mW semiconductor laser beam was used as light source to illuminate the surface of apples (cv. Red Fuji and cv. Gala). The scattering images were captured by a computer vision system and the total number of pixels in the image was taken by a threshold segmentation method. The purposes of the experiment were to study whether the different sizes and different sides (background and blush side) of apples show effects on the number of pixels in the images, and establish models between the image parameters and apples' qualities parameters. Two groups of 100 apples were stored at 20°C and relative humidity of 65% for a period of 6 weeks. The image parameters (S1,S2,S1-S2,S1/S2) were measured. The results indicated that the different sizes of apples had no significant differences on the total pixels in the scattering images, while the different sides of apples had significant differences ($P \leq 0.05$). The image sizes (the number of pixels) got by the laser beam from apples was increasing significantly ($P \leq 0.05$) following the ripeness. It was found that S1-S2, one of the image parameters, had the highest Pearson correlations with the quality parameters. The stepwise regression analysis showed that the models had the best representative when the parameter S1-S2 (the highest $R^2=0.99$) was used, and the models were significant ($P \leq 0.01$). The models had been validated by the experiments of additional 40 apples, and results indicated that the calculated and measured quality parameters were in good agreement (The minimum average error was 2.25% for H° value, while the maximum average error was 11.41% for a* value). This trial laid a theoretical basis for applying low power laser beam to monitor the apples' ripeness and quality.