P5-26

The Near-Infrared Imaging Spectroscopy to Visualize the Distribution of Sugar Content in the Flesh of a Melon

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To improve the accuracy of sweetness sensor in automated sorting operations, it is necessary to clarify unevenness of the sugar content distribution within fruits. And it is expected that the technique to evaluate the content distribution in fruits contribute to the development of the near-infrared (NIR) imaging spectroscopy. Sugiyama (1999) had succeeded to visualize the distribution of the sugar content on the surface of a half-cut green fresh melon. However, this method cannot be applied to red flesh melons because it depends on information of the absorption band of chlorophyll (676 nm), which is affected by the color of the fresh. The objective of this study was to develop the universal visualization method depends on the absorption band of sugar, which can be applied to various kinds of melons and other fruits.

The relationship between the sugar contents and absorption spectra of both green and red fresh melons were investigated by using a NIR spectrometer to determine the absorption band of sugar. The combination of 2nd derivative absorbances at 902 nm and 874 nm was highly correlated with the sugar contents. The wavelength of 902 nm is attributed to the absorption band of sugar. A cooled charge-coupled device (CCD) imaging camera which has 16 bit (65536 steps) A/D resolution was equipped with rotating band-pass filter wheel and used to capture the spectral absorption images of the flesh of a vertically half-cut red fresh melon. The advantage of the high A/D resolution in this research is that each pixel of the CCD is expected to function as a detector of the NIR spectrometer for quantitative analysis. Images at 846 nm, 874 nm, 902 nm and 930 nm were acquired using this CCD camera. Then the 2nd derivative absorbances at 902 nm and 874 nm at each pixel were calculated using these four images. On the other hand, parts of the same melon were extracted for capturing the images and squeezed for the measurement of sugar content. Then the calibration curve between the combination of 2nd derivative absorbances at 902 nm and 874 nm and sugar content was developed. The calibration method based on NIR spectroscopy techniques was applied to each pixel of the images to convert the 2nd derivative absorbances into the Brix sugar content. Mapping the sugar content value of each pixel with linear color scale, the distribution of the sugar content was visualized. As a result of the visualization, it was quantitatively confirmed that the Brix sugar contents are low at the near of the skin and become higher towards the seeds. This result suggests that the visualization technique by the NIR imaging spectroscopy could become a new useful method for quality evaluation of melons.