Near infrared determination of soluble solids in intact melons from a progeny by non-contact mode using a fibre-optic probe

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Introduction

A previous paper has described the improvement of standard errors of the predicted soluble solids (Brix) in a melon cultivar by non-contact mode using near infrared (NIR) spectroscopy.[1] We then examined mature and immature fruits to provide a broad range of Brix. The objective of this study was to determine the potential of NIR spectroscopy for non-destructive estimation of Brix in melon breeding programmes.

Materials and methods

F_3, F_4, F_5 and F_6 plants, derived from the cross between 'PMAR No.5' and 'Harukei 3', were used as samples. The F_3 and F_4 plants were grown in a plastic greenhouse at NIVTS in 2000, the F_5 and F_6 plants were grown in 2001 and the parents were grown during both years. The harvesting stage of the fruits was judged mainly by external appearance (yellowing of rind and/or formation of abscission layer and so on). The optical absorption spectra were measured using a NIRSystems model 6500 spectrophotometer equipped with a fibre optic probe (Silver Spring, MA, USA). To measure the optical absorption spectra, each fruit was hand-placed with several mm distance apart from the end of the probe so that the blossom end was centred (Non-contact mode).[1] The original spectra were converted to the 2nd derivative spectra. Fruits (n = 31) that were harvested early in 2000 were used as a calibration sample set. A commercial program (NSAS ver. 3.27) was used for multiple linear regression analysis. The other fruits were used as prediction sample sets. Following optical measurement, a piece of tissue was cut out from the blossom end with a cork borer (diameter 18 mm). To obtain its juice, the tissue was comminuted with a grater and centrifuged. Brix of the juice was determined using a temperature compensated refractometer (ATAGO model DBX-55, Japan).

Results

For the calibration sample set (n = 31), *SEC* was 1.27%, with an *MR* of 0.869. The wavelengths selected in the regression equation were 902, 878 and 850 nm [Figure 1(a)]. For the prediction sample sets (n = 40 in 2000, n = 26 in 2001), their *RMS* were 1.09 [Figure 1(b)] and 1.58% [Figure 1(c)] respectively. As mentioned above, Brix in the melons from a progeny could be estimated well.

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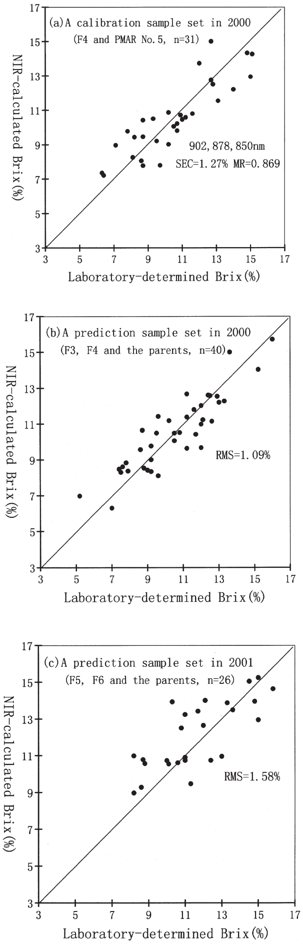

Figure 1. Plots of laboratory-determined Brix vs NIR-calculated Brix for the melons from a progeny.

Discussion

Absorbances at 902, 878 and 850 nm were included in the multiple regression equation as independent variables and the former two wavelengths are key wavelengths for non-destructive Brix determination. Many researchers have selected similar wavelengths for Brix prediction in melons,[1,2] onions,[3] peaches,[4–6] nectarins[6] and pineapples.[7]

Usually, individual cultivar calibrations are successful while predicting Brix in the same cultivar's prediction sample set within the same season. Practically, a calibration equation will be applied to other samples. In this case, the absolute value of a bias sometimes becomes large.[5] In this experiment, fruits that were harvested early in 2000 were used as the calibration sample set. The other fruits were used as the prediction sample sets. The size, weight, netting, surface colour, flesh colour, length of flesh and so on of the melons were more various than those of a melon cultivar (Data not shown). Nevertheless, Brix in the melons could be estimated well (Figure 1).

The previous paper has described improvements in standard errors of the predicted Brix in the melon cultivar by non-contact mode using NIR spectroscopy.[1] We then examined the mature and immature fruits to provide a broad range of Brix. In this experiment, when the results of the non-contact mode were compared with those of the contact mode (usual method), the former mode also improved the latter standard errors in spite of the fruits being almost mature (Data not shown).

Conclusion

NIR spectroscopy could estimate Brix in the melons from a progeny well. 902 and 878 nm, which are the key wavelengths for non-destructive Brix determination, were included in the multiple regression equation as independent variables. Non-contact mode could improve standard errors of the progeny as well as a cultivar compared with contact mode (usual method). It was concluded that NIR spectroscopy could be used for non-destructive measurement of critical selection traits (Brix) in melon breeding programmes.

References

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