

Comparison of two VIS-NIR instruments based on reflectance or interactance mode for fruit quality measurements

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Introduction

Determining fruit quality using classical destructive methods is time consuming, costly and only a limited number of fruits can be processed. Since instruments based on different measurement modes are commercially available, it needs to be assessed which one is the most suitable for each particular situation.

Objective of the study

Testing the performance of two instruments working in interactance or reflectance mode for the measurement of total soluble solids of eight types of fruit differing in:

- **calibre** (strawberry vs. melon)
- **water content** (tomato vs. pip fruit)
- **skin thickness** (melon vs. stone fruit)

Material and Methods

- 8 types of fruit (apples, pears, apricots, peaches, nectarines, melons, tomatoes, strawberries).



- NIR measurements (350-1100 nm) using (1) NIR Case (SACMI, Italy) and (2) QualitySpec® Pro (ASD, USA). Same fruit batches were measured on both instruments.
- Reference values: total soluble solids (TSS, °Brix).
- Statistical analyses: PLS regression in the wavelength range 650-970 nm.

Results

Typical spectra of the eight types of fruit obtained with NIR Case respectively QualitySpec® Pro are shown in figure 1. The main spectral differences between the different fruit types are in the region between 450 and 950 nm for both instruments.

Based on the values of R^2 , RMSECV and RPD of the cross-validations (table 1) the NIR Case instrument (NC) showed a higher performance in terms of accuracy for measuring TSS of fruit compared to QualitySpec® Pro (QS).

	Number of samples	Mean	S.D.	range	Pre-treatment		R^2		RMSECV		RPD	
					NC	QS	NC	QS	NC	QS	NC	QS
Apple	80	12.3	1.7	8.8-17.2	MSC	SG 5-2	0.92	0.83	0.48	0.67	3.5	2.5
Pear	96	12.1	1.4	9.1-15.7	MSC	SG 5-2	0.90	0.88	0.43	0.47	3.2	2.9
Peach	100	9.4	1.2	6.6-12.1	MSC	SG 5-2	0.87	0.82	0.44	0.51	2.7	2.3
Nectarine	85	9.9	1.0	7.4-12.6	SNV	SG 5-2	0.94	0.86	0.25	0.39	4.1	2.6
Tomato	94	4.6	0.8	3.1-6.6	SG 5-2	SNV	0.90	0.79	0.26	0.39	3.2	2.4
Apricot	205	14.5	2.0	8.8-21.4	MSC	SG 1-5-2	0.90	0.88	0.58	0.71	3.5	2.8
Melon	56	11.1	2.1	6.7-14.5	SNV	SG 5-2	0.89	0.84	0.70	0.87	3.0	2.4
Strawberry	78	7.6	1.2	3.8-10.4	SNV	SG 5-2	0.94	0.88	0.32	0.44	3.9	2.8

Table 1. Cross-validations of the NIR calibrations for total soluble solids (°Brix) obtained for the measured range of fruit. NC: NIR Case, QS: QualitySpec® Pro, R^2 : coefficient of determination, RMSECV: root mean square error of cross-validation, RPD: residual predictive deviation.

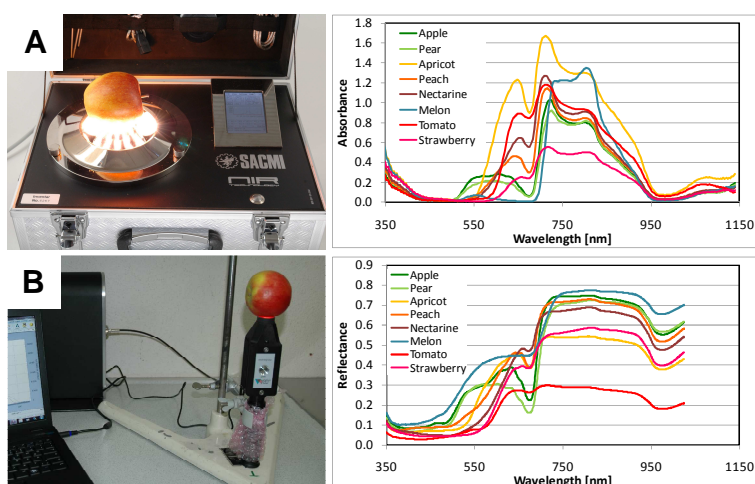


Figure 1. Examples of average spectra of the measured range of fruit (apple, pear, apricot, peach, nectarine, melon, tomato, strawberry) obtained with: **A:** NIR Case (interactance) and **B:** QualitySpec® Pro (reflectance).

Conclusions

- The NIR Case instrument based on interactance mode is more accurate for measuring TSS of fruit than the QualitySpec® Pro instrument based on reflectance mode.
- The NIR Case instrument showed a good accuracy for very different fruit types such as tomatoes (high water content), melons (thick skin and large calibre) and strawberries (small calibre).
- The good performance is also a result of the instrumental setup of the NIR Case which has been especially designed for fruit quality measurements.