NIR based technological innovation for assessing the quality and authentication of agricultural and food productions

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Introduction

Near infrared spectroscopy (NIR) is evolving to bring its use closer to the sample and to give an immediate results for the final user. In such direction and since a decade the number of **portable instruments based on NIR** has been drastically increased. Two main questions arise from this rapid development:

- How good are these instruments compared to classical benchtop devices?
- Are all of them of equal quality?

- The main characteristics of portable instruments are their compact appearance, the **ease of use**, the fact that they can be controlled via a smartphone (or even a watch) with a wired or **wireless connection**, and their **low cost** compared with conventional infrared devices. Some can also be adapted to include predictive models for the simultaneous determination of various quality parameters, or can be coupled to a **GPS** device enabling **geolocation of measurements**. Some can also be connected to a cloud in order to offer **custom-made solutions** or directly embedded into a smartphone.

- This new kind of instruments must be subject to **rigorous evaluation** to ensure that they represent a real opportunity for those working in the world of agriculture and food. Furthermore, they require **optimization of the measurement protocols** in order to take into account the heterogeneity of the products, **adaptation regarding sample presentation** and the development of **adequate calibration strategies**. For this reason, the CRA-W has been evaluating some of these portable instruments available in the market for several years (2008 - ….).

A practical study

- A mini study conducted by CRA-W consisted of dividing its grass/hay database (≈ 5000 spectra) **from a benchtop instrument** into 2 equal sets and predicting by **local method** half of the samples with the remaining samples and by using the **wavelength ranges of portable instruments**.

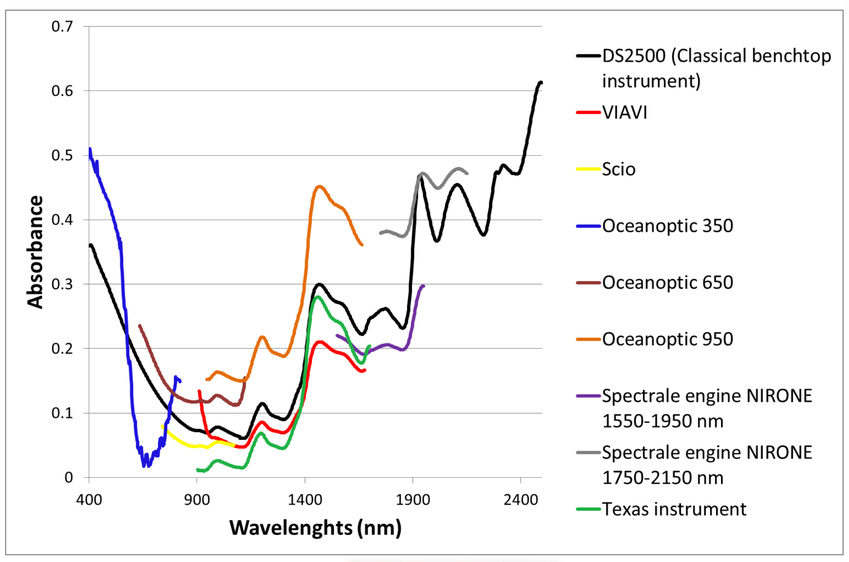
Handheld devices available at CRA-W

740 – 1070 nm

1550 – 1950 nm
1750 – 2150 nm

338 – 822 nm
634 – 1122 nm
948 – 1664 nm

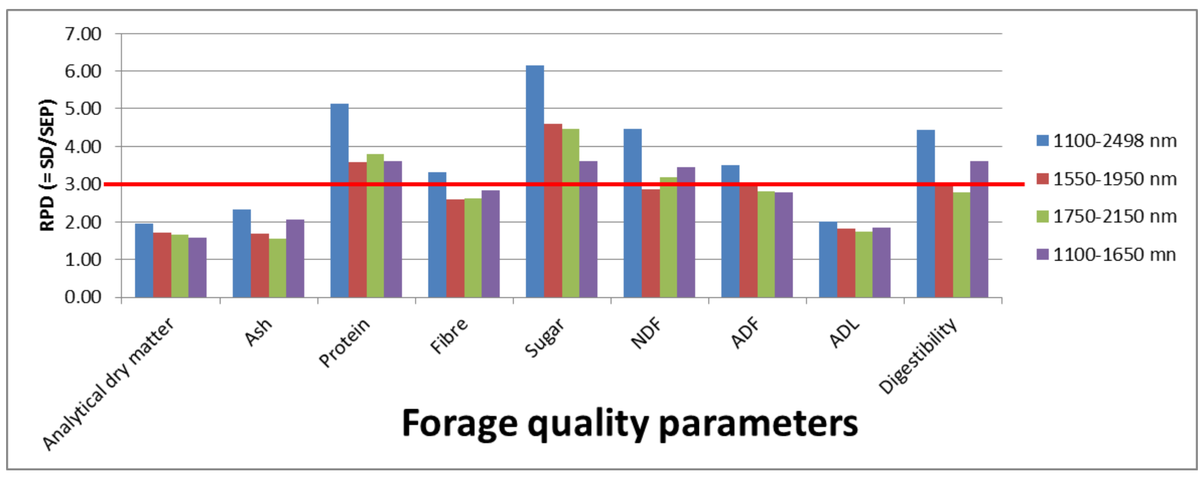
900 – 1700 nm



920 – 1650 nm

310 – 1100 nm

Comparison of performance of different spectral range of the handheld devices investigated



- In normal conditions, RPD value (RPD = SD / SEP) is probably the best parameter to assess the accuracy of a calibration. (SD = standard deviation SEP = standard error of predictions)
  As shown on the graph, the spectral range can have a significant influence especially for critical parameters like protein or digestibility in forage.
  Naturally every application is specific and sometimes the key parameter is not accuracy but the **cost** or the "**portability**".
  Anyway, before considering the use of a portable device a **preliminary study** can be useful to evaluate the maximum potential of such spectrometers.

Conclusion

- CRA-W is working on the most suitable **methodology for transferring databases** constructed during decades, with benchtop devices, to this new generation of portable instruments [1].

- These portable devices will, in a near future, play an increasing part in our farms and businesses, to determine the key parameters necessary to bring quality control as close as possible to the place where the sample is produced. They will form an **integral part of future decision-making tools**, including precision food production, raw material quality control, batch segmentation, product traceability and fraud detection. They will increasingly support the ongoing digital revolution in our farms and businesses.

Reference

[1] Fernández Pierna, J.A. , Vermeulen, P. , Lecler, B. , Baeten, V. & Dardenne, P. (2010). **Calibration transfer from dispersive instruments to handheld spectrometers**. Applied Spectroscopy, 64: (6), 644-648.

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