Application of NIRS technology to sugar beet breeding programs for energetic uses

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1. Introduction

Sugar beet breeding programs have traditionally been focused on developing varieties combining outstanding agronomic performance and improved quality characteristics for human consumption. With the recent interest in bio-fuels, new breeding criteria, mostly associated with several new quality parameters, need to be taken into consideration to develop varieties adapted to ethanol production. In consequence, it would be desirable to determine the bioethanol production potential of a particular variety directly from a beet sample. Most of the analytical methods used are costly and time consuming.

2. Objetives

- To evaluate NIRS technology as a fast and cost efficient tool to accurately predict key beet quality parameters involved in ethanol production.
- To explore the ability of NIR to directly estimate the ethanol yield of a sugar beet sample.

3. Material and methods

Samples

- 75 sugar beet samples from 2006/07 and 2007/08 campaigns were obtained from north and south locations in Spain.

Chemical analyses

- Sugar beet: sucrose (%) and total sugars (g/l).

Fermentation

- Bioethanol production (g/l).

Equipment

- FOSS-NIRSystems 6500, DCFA module. Reflectance analyses.

4. Results and Discussion

Figure 1. Reflectance spectra of the sugar beet set.

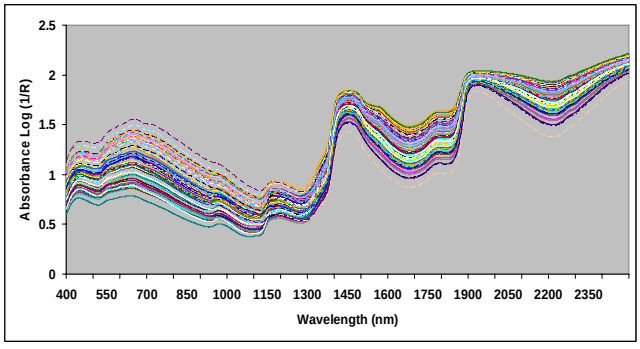
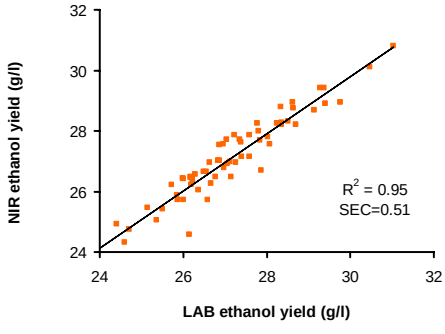


Table 1. Calibration statistics obtained for NIR quality control of sugar beet brei.

Parameter	Wavelength (nm)	N	MEAN[a]	SD[b]	SECV[c]	r^{2d}	RPD[e]
Sucrose (%)	400-2500	75	16.45	1.08	0.22	0.96	4.9
Total sugars (g/l)	1100-2500	75	64.49	5.48	1.58	0.92	3.5
Ethanol yield (g/l)	1100-2500	75	26.53	2.01	0.54	0.93	3.7

[a] Mean of the calibration set; [b] Standard deviation; [c] Standard error of cross-validation; [d] Coefficient of determination of cross-validation; [e] RPD: ratio SD/SECV

Figure 2. Reference data (x-axis) *versus* NIRS predicted values (y-axis) of the ethanol yield MPLS regression model.



The results confirm the viability of NIR technology as a useful tool in the pre-selections of varieties in sugar beet breeding programs as it rapidly provides quality parameters, as well as the bioethanol yield of a sample with enough precision and reliability.

Further work is in progress to increase the variability and the robustness of the equations developed for the NIR analysis of sugar beet.

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