ON-LINE NEAR INFRARED SPECTROSCOPY AND CHEMOMETRICS FOR CHARACTERIZATION OF OLIVE OILS AT THE EXIT OF A DECANTER CENTRIFUGE

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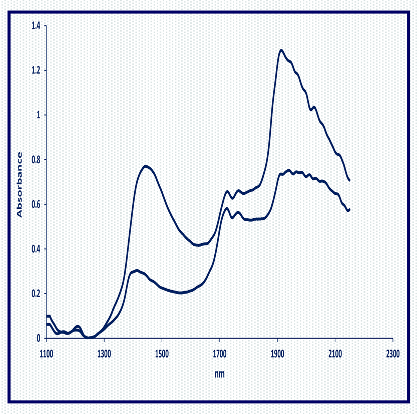
1. Introduction

In the last years, successful results are being obtained from the on-line implementation of NIR technology in the olive mill industry. In combination with chemometric tools, this technique was applied for the on-line analysis of quality parameters of olive fruit, olive pomace and olive oil which enhance an effective optimization of the extraction process in terms of productivity and quality. However, and in order to maintain a high level of extraction yield, real-time knowledge of oil characteristics at the exit of the horizontal centrifugal decanter (HCD) is required. For this reason, the aim of this study was to predict on-line moisture, impurities and polyphenols content in oils when coming out from the HCD.

2. Material and methods

Two-phase experimental olive mill installed at IFAPA "Venta del Llano"
Four consecutive crop seasons
(2009/2010, 2010/2011, 2011/2012 and 2012/2013)

- On-line acquisition of NIR spectra through an AOTF-NIR reflectance sensor placed at the exit of oil from the decanter (Brimrose Corp. EEUU)



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- Collection of technological variables related to the process: Olive paste temperature and flow, water olive paste dilution, oil-off carrier position on HCD, position of feed tube and oil temperature (Table1)

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- Collection of oil samples for reference analysis in laboratory
  - Moisture (ISO 662, 1998)
  - Impurities (ISO 663, 2007)
  - Polyphenols (Vázquez-Roncero et al., 1973)

Chemometric data analysis

SNV pre-processing spectra followed by PCA

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Duplex method for selection of calibration and validation sets (Snee, 1977)

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For both sets, the corresponding technological variables were normalized and included into the spectral datasets

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Development of ANN and SVM models respectively with Matlab (version 7.10, The Mathworks Inc.) and PLS Toolbox package for Matlab (version 7.5.5, Eigenvector Research, Inc.)

Figure 1. Flowchart of the procedure followed in this study

Table 1. Range of technological variables used for models construction

Technological variables	Range values
Olive paste temperature (ºC)	9.0-36.7
Olive paste flow (kg/h)	460-1300
Water olive paste dilution (l/h)	0-200
Oil off-carrier position on HCD (mm)	98-99-100
Position of feed tube (cm)	0-13.0-27.5
Oil temperature (ºC)	15.9-35.5

3. Results

Table 2. Descriptive statistics obtained for oil samples by reference analysis

	Data set	Samples	Mean	S.D.	Min-Max
Moisture	Calibration	515	9.04	9.32	0.70-52.11
	Validation	127	8.21	8.46	0.60-44.94
Impurities	Calibration	515	1.71	1.96	0.03-14.56
	Validation	127	1.46	1.58	0.05-8.57
Polyphenols	Calibration	515	1248	989	135-6414
	Validation	127	1311	1143	164-7227

Table 3. Results of ANN and SVM models to predict moisture, impurities and polyphenols

	Chemometric method	R^2	RMSEP	
Moisture	ANN	0.780	4.54	
	SVM	0.952	4.18	A
Impurities	ANN	0.886	1.18	
	SVM	0.905	0.64	B
Polyphenols	ANN	0.875	656	
	SVM	0.954	592	C

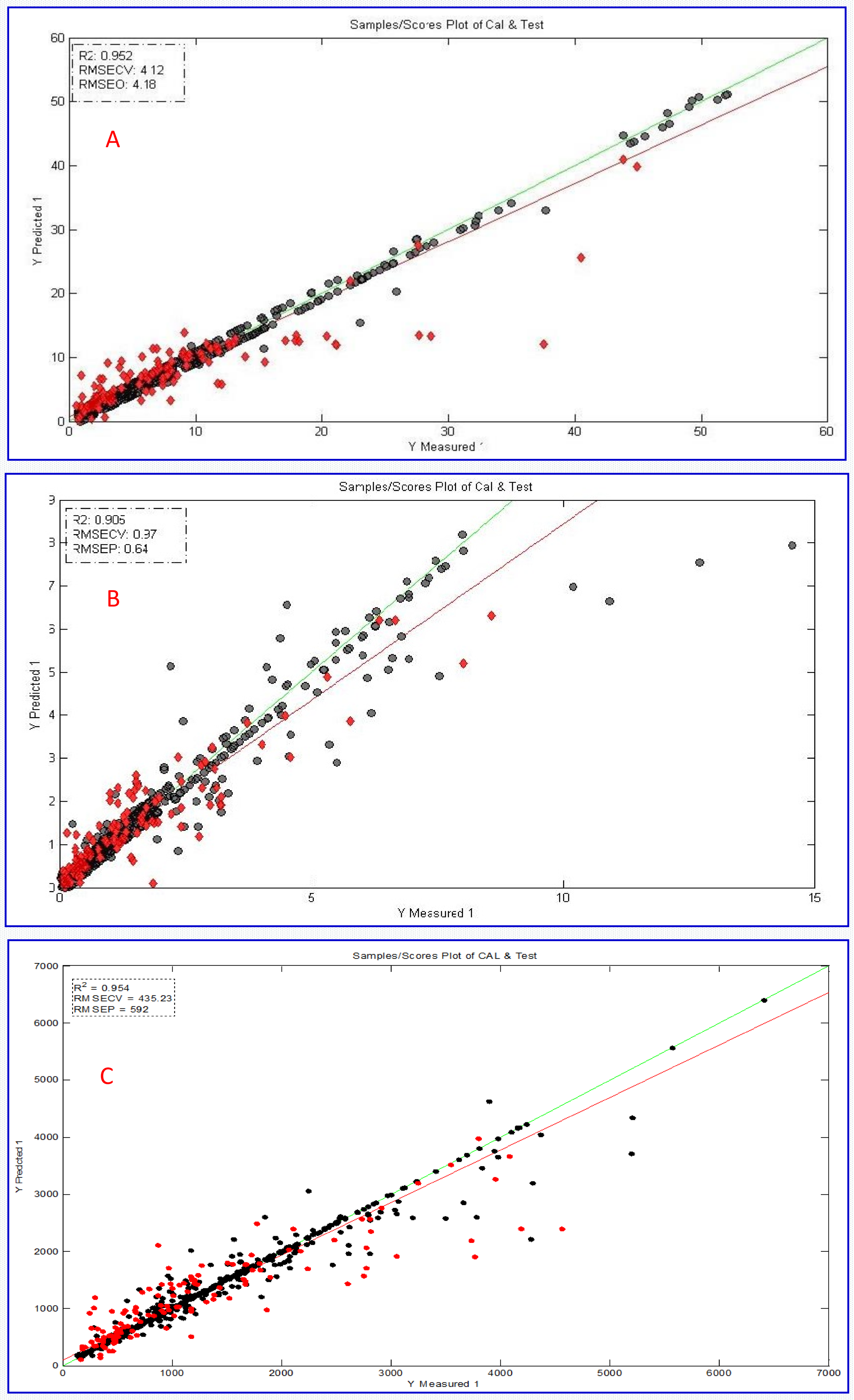

Figure 2. AOTF-NIR predicted data versus reference data obtained by SVM for moisture (A), impurities (B) and polyphenols (C)

4. Conclusion

- The obtained results indicate the feasibility of on-line NIR prediction combined with technological variables from the process for the characterization of oils at the exit of the HCD.
- SVM models provide more accurate predictions than ANN.
- These findings should allow the regulation and optimization of the decanter centrifuge operation with a minimum loss of time and costs.

5. References

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6. Acknowledgements

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