

Use of spectroanalytical techniques for the evaluation of sugarcane sugar

By Douglas Romano Beletti

Analytical technology in food and agriculture

Brazil is the largest sugarcane producer in the world, and its consolidated industry also places it in the position of the largest producer and exporter of sugar. With a highly variable process and also with large transported volumes, the control of tampering and analysis of its physical chemical parameters becomes a crucial step at various points in its supply chain, establishing quality standards and its final demand. Given the importance of control, in the laboratory scope, new techniques and applications are sought that enable quick, non-destructive analysis, not using harmful reagents and also easy to operate, and that this allows for quick actions that lead to improvements in the efficiency of the processes decrease in losses. Thus, the objective of this work is the evaluation and development of new applications for sugar analysis using the Laser Induced Plasma Optical Emission Spectrometry (LIBS) and Near Infrared Region Spectroscopy (NIRS) techniques. In the first part of this study 64 samples of mixture were prepared, and using chemometric tools, PLS models were developed and optimized to determine the parameters Sugar (%), Sand (%) and Black Spots (pp/100g). For performance evaluation, the RMSEP values were obtained for the prediction models for Sand at 6.48, 1.29 and 5.96 percent, for Sugar at 6.53, 1.23 and 5.99 percent and for Black Spots at 7.74, 5.81 and 10.94 bp/100g of sample, each of which is obtained with the LIBS, NIR and Data Fusion data respectively. In the second part of this study, spectroanalytical data from 41,110 samples of Crystal, VHP, Amorphous Refined and Granulated Refined sugars were collected via NIRS in different regions of Brazil and mPLS and ANN prediction models were developed for Ash (% m/m), Color ICUMSA (UI), Polarization ($^{\circ}$ Z) and Humidity (%). Individual mPLS and ANN models were compared with a global model (containing all types of sugar), with the literature and also with a proficiency test applied in industry laboratories. For the ANN models of the Global calibration, it was possible to obtain RMSEP values of 0.017 for ash, 43 for color, 0.016 for moisture and 0.098 for Pol. Therefore, the LIBS technique showed promise in the evaluation of contaminants in sugar, and can be evaluated for development of routine applications obtaining greater spectral variability. The NIRS technique for sugar evaluation demonstrated an advanced state of development and robustness due to global variability and performance when compared to literature and laboratory techniques.