Fraud control in canephora coffee by NIR and one-class classification method: a study with Amazonian Robustas beans

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Abstract:
The canephora coffee produced in the state of Rondônia - Brazil, the Amazonian Robusta coffee, obtained a geographical indication of the denomination of origin type, which is granted to products that have unique characteristics due to the geographical environment, including natural and human factors. Amazonian Robusta coffees have higher commercial value, thus the fraudulent practice of labeling low-cost coffees as Amazonian Robusta coffees needs detection. In this context, coffee authentication is a challenge using traditional analytical techniques. Thus, the present study aimed to develop a method, using near infrared spectroscopy (NIR) combined with data driven-soft independent modeling of class analogies (DD-SIMCA), a one-class classification method, recently developed for non-destructive authentication of green beans from Amazonian Robustas coffees. To this end, spectra of Amazonian Robusta coffees (n=114), canephora coffees from other regions (n=108) and arabica coffees (n=12) were collected without sample preparation. The samples were directly analyzed by diffuse reflectance in a FT-NIR system, using a NIRA accessory equipped with a spinning sample module. The scanning spectra were obtained in triplicate in the spectral range between 10,000 cm^{-1} and 4,000 cm^{-1}, with a resolution of 4 cm^{-1} and 16 scans. The samples were separated into training (70% of the samples) and test (30%) sets by the Kennard-Stone algorithm. The classification model built based on the full spectra showed 100% correct assignments for Amazonian Robustas samples and for other coffees, respectively, correctly recognizing all samples in the training and test sets. In this sense, the combination of NIR and DD-SIMCA proved efficient to control the authenticity of the studied coffees. Therefore, the proposed methodology can be useful for applications in quality control and origin certification procedures for Amazonian Robustas beans with geographical indication of the denomination of origin type by direct analysis of the samples, without any type of preparation.

Keywords: Near Infrared Spectroscopy. Chemometrics. Green coffee.