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Detection of High Fructose Corn Syrup in Honey by Near Infrared Spectroscopy and Chemometrics

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Abstract : The National Service of Agri-Food Health and Quality (SENASA), controls honey to detect contamination by synthetic or natural chemical substances and establishes and controls the traceability of the product. The utility of near-infrared spectroscopy for the detection of adulteration of honey with high fructose corn syrup (HFCS) was investigated. First of all, a mixture of different authentic artisanal Argentinian honey was prepared to cover as much heterogeneity as possible. Then, mixtures were prepared by adding different concentrations of high fructose corn syrup (HFCS) to samples of the honey pool. 237 samples were used, 108 of them were authentic honey and 129 samples corresponded to honey adulterated with HFCS between 1 and 10%. They were stored unrefrigerated from time of production until scanning and were not filtered after receipt in the laboratory. Immediately prior to spectral collection, honey was incubated at 40°C overnight to dissolve any crystalline material, manually stirred to achieve homogeneity and adjusted to a standard solids content (70° Brix) with distilled water. Adulterant solutions were also adjusted to 70° Brix. Samples were measured by NIR spectroscopy in the range of 650 to 7000 cm^{-1}. The technique of specular reflectance was used, with a lens aperture range of 150 mm. Pretreatment of the spectra was performed by Standard Normal Variate (SNV). The ant colony optimization genetic algorithm sample selection (ACOGASS) graphical interface was used, using MATLAB version 5.3, to select the variables with the greatest discriminating power. The data set was divided into a validation set and a calibration set, using the Kennard-Stone (KS) algorithm. A combined method of Potential Functions (PF) was chosen together with Partial Least Square Linear Discriminant Analysis (PLS-DA). Different estimators of the predictive capacity of the model were compared, which were obtained using a decreasing number of groups, which implies more demanding validation conditions. The optimal number of latent variables was selected as the number associated with the minimum error and the smallest number of unassigned samples. Once the optimal number of latent variables was defined, we proceeded to apply the model to the training samples. With the calibrated model for the training samples, we proceeded to study the validation samples. The calibrated model that combines the potential function methods and PLSDA can be considered reliable and stable since its performance in future samples is expected to be comparable to that achieved for the training samples. By use of Potential Functions (PF) and Partial Least Square Linear Discriminant Analysis (PLS-DA) classification, authentic honey and honey adulterated with HFCS could be identified with a correct classification rate of 97.9%. The results showed that NIR in combination with the PT and PLS-DS methods can be a simple, fast and low-cost technique for the detection of HFCS in honey with high sensitivity and power of discrimination.

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