Sensor Fusion and Interpretation of Chemical Information in the Performance Profiles of Miniaturized NIR Sensors in Food Analytical Framework

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Handheld NIR spectrometers are becoming essential in food analytical framework (Bec, Grabska and Huck, 2020). However, sensor miniaturization requires implementing a number of distinct engineering solutions, and these sensors differ by the key elements used for their construction, performance and applicability. Recent advancements have brought feasibility of theoretical *in silico* simulation of NIR spectra (Bec and Huck, 2019; Ozaki et al., 2021). Narrow spectral working regions of miniaturized instruments limit their ability to measure meaningful vibrational bands, making them selective towards specific chemical constituents in food matrices. Through *in silico* approach, the location of meaningful variables can be associated with specific molecular vibrations. The sensitivity and specificity of a sensor to chemical information from a given ingredient in a complex NIR lineshape of a food sample can be determined enabling smart design of NIRS application (Grabska et al., 2021).

Detailed comprehension of the analysed spectral signal opens the pathway to knowledge-based design of the food analytical framework by NIRS towards better performance. A direct improvement of performance of sensors with mutually exclusive operational spectral regions may be accomplished by data fusion. Several cost-effective miniaturized NIR sensors appeared at the market, specifically intended for food analysis. Sensor fusion offers convenient uplift in performance by combining spectra measured in different wavenumber regions enabling an extended access to chemical information for more reliable calibration.

**Keywords:** sensor fusion, chemical interpretation of calibration models, in silico NIR spectroscopy

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