NIR spectroscopy and chemometrics against food fraud: spotting Mechanically Separated Meat (MSM) in processed meat products

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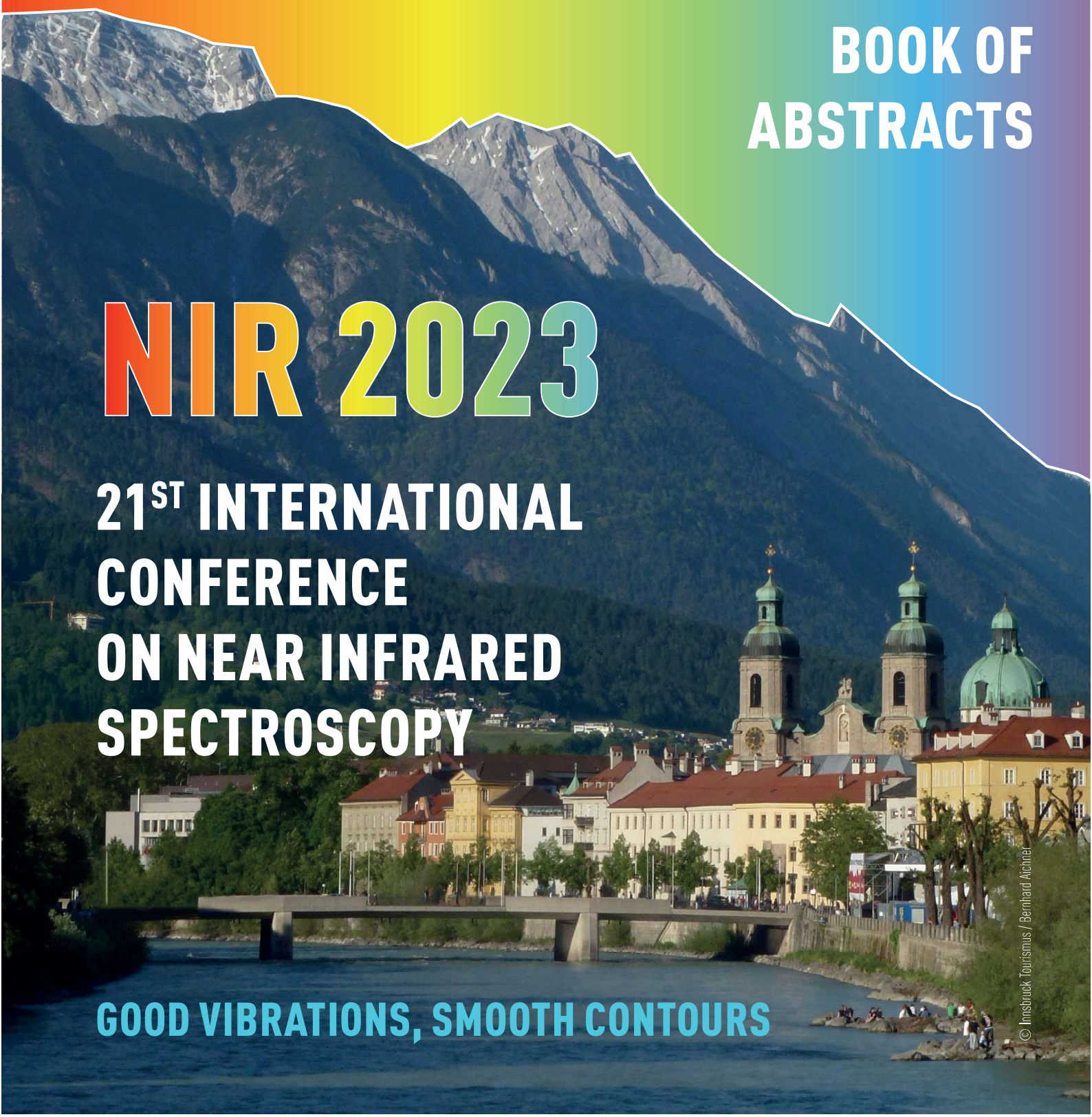

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NIR SPECTROSCOPY AND CHEMOMETRICS AGAINST FOOD FRAUD: SPOTTING MECHANICALLY SEPARATED MEAT (MSM) IN PROCESSED MEAT PRODUCTS

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Along the meat production chain, mislabelling and meat substitution can take place easily. This is typically the case of sausages in which minced meat can be intentionally replaced with Mechanically Separated Meat (MSM), partially or completely, with no mention in the product label. MSM is obtained by separating from the bone the edible tissues remaining after slaughter, under high pressure conditions. The quality and safety of this product are far lower than minced meat obtained by selected meat cuts, leading not only to health risks and deception for consumers, but also to a considerable economic advantage for producers [1].

In this study, NIR spectroscopy coupled with chemometrics was investigated as a rapid, non-destructive, cheap and green method primarily to discriminate between MSM and non-MSM samples and, as a second step, to quantify the amount of MSM. In order to investigate the suitability of both laboratory and onsite NIR acquisitions, three NIR spectrometers were considered: a benchtop NIR – MPA (Bruker) and two portable ones, i.e., MicroNIR (Viavi) and SCiO (Consumer Physics). The spectra acquired with each instrument were organized as a separated dataset and the same processing steps were operated on each of them.

For the classification step, 70 samples of poultry (chicken and turkey) sausages, including non-MSM and MSM samples, were longitudinally half cut and analysed. After exploratory analysis with PCA (Figure 1a), the spectra were used to build a PLS-DA model for each NIR dataset. For the regression step, sausages with different percentages of MSM were minced and mixed with non-MSM ones to obtain mixture samples with a specific MSM content. One PLS [2] model for each dataset was developed using a training set of 30 samples spanning a MSM content between 0% and 91% (in steps of 10%) and validated with a test set of 27 samples starting from the 5% of MSM content (in steps of 10%, until the 85%).

All the three NIR analytical techniques yielded good prediction performances both in classification, with model accuracies higher than 95%, and in regression (Figure 1b), with R^2 above 0.95 and RMSEP of 3.30%. These promising results suggest a successful applicability of the method, also using cheap portable instruments, to detect food frauds directly in the marketplace.

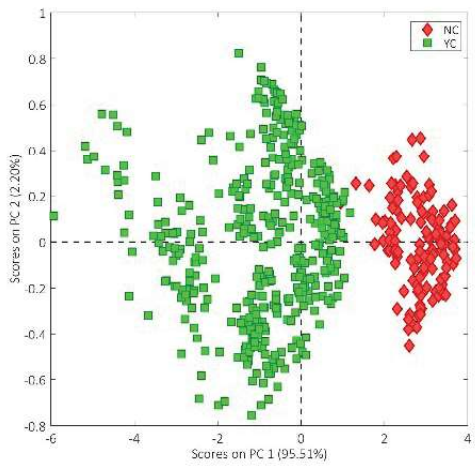

Fig 1a - PCA scores plot on SCiO spectra

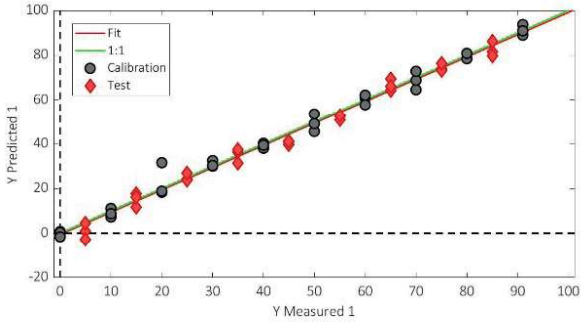

Fig. 1b - PLS results with SCiO spectra

[1] Barrere, V., et al. 2020. Food fraud vulnerability assessment: Towards a global consensus on procedures to manage and mitigate food fraud. Trends in Food Science and Technology, 100, 131-137. https://doi.org/10.1016/j.tifs.2020.04.002
[2] Wold, S., et al. 2001. PLS-regression: a basic tool of chemometrics. Chemometrics and Intelligent Laboratory Systems, 58, 109-130. https://doi.org/10.1016/S0169-7439(01)00155-1

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