Application of handheld near infrared spectroscopy to assess fruit extract enrichment in sour cherry juice

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Introduction

The growing interest in healthy eating has undoubtedly increased the demand for fortified food products enriched with beneficial compounds such as vitamins, antioxidants, and minerals. To ensure their consistent quality and composition, thorough analysis is crucial. In our study, we used near infrared spectroscopy (NIRS) as a non-destructive and increasingly popular method in food analysis, as a fast and effective tool to evaluate the fortification of fruit juices.

Goals

This aims to detect and quantify the presence of various fruit extracts added to sour cherry juices using near infrared spectroscopy.

Sample preparation

Cranberry, grapeseed, and pomegranate extracts were added into sour cherry juices in simple, binary, or ternary combinations at concentrations between 0-2.5 g/100 mL (see Fig.1), then pasteurized in a drying chamber (85 °C, 60 s).

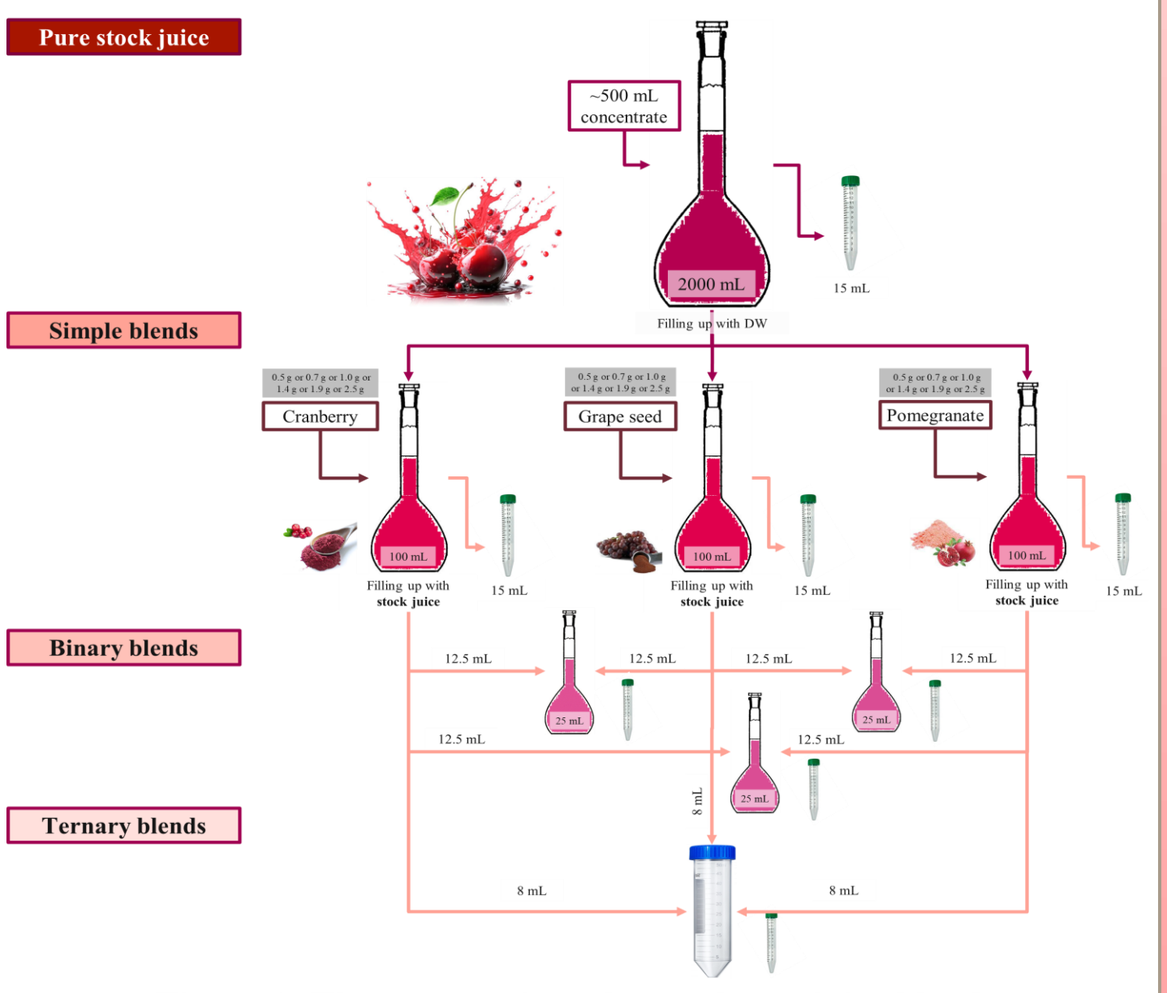

Figure 1. The preparation of sour cherry juice blends

Applied methods

Transflectance spectra of 129 samples in total were randomly129 recorded using handheld NIR spectrometer and evaluated within the wavelength range of 1350-1850 nm (Fig. 2).

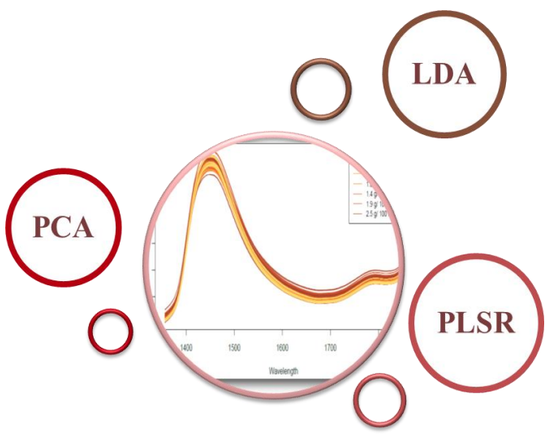

Figure 2. Applied chemometric methods

Classification:

- ✓ To trace the effect of extract addition;
- ✓ Detect the level of enrichment.

Extract content prediction:

- ✓ separate modelling by extract type;
- ✓ determination of regression vectors.

Results

The classification results revealed clear separation trends, particularly according to extract concentration. Predictive modeling yielded coefficients of determination (R^2) exceeding 0.9 and root mean square errors (RMSE) significantly lower than 0.5 g/100 mL during both calibration and validation (Fig. 3).

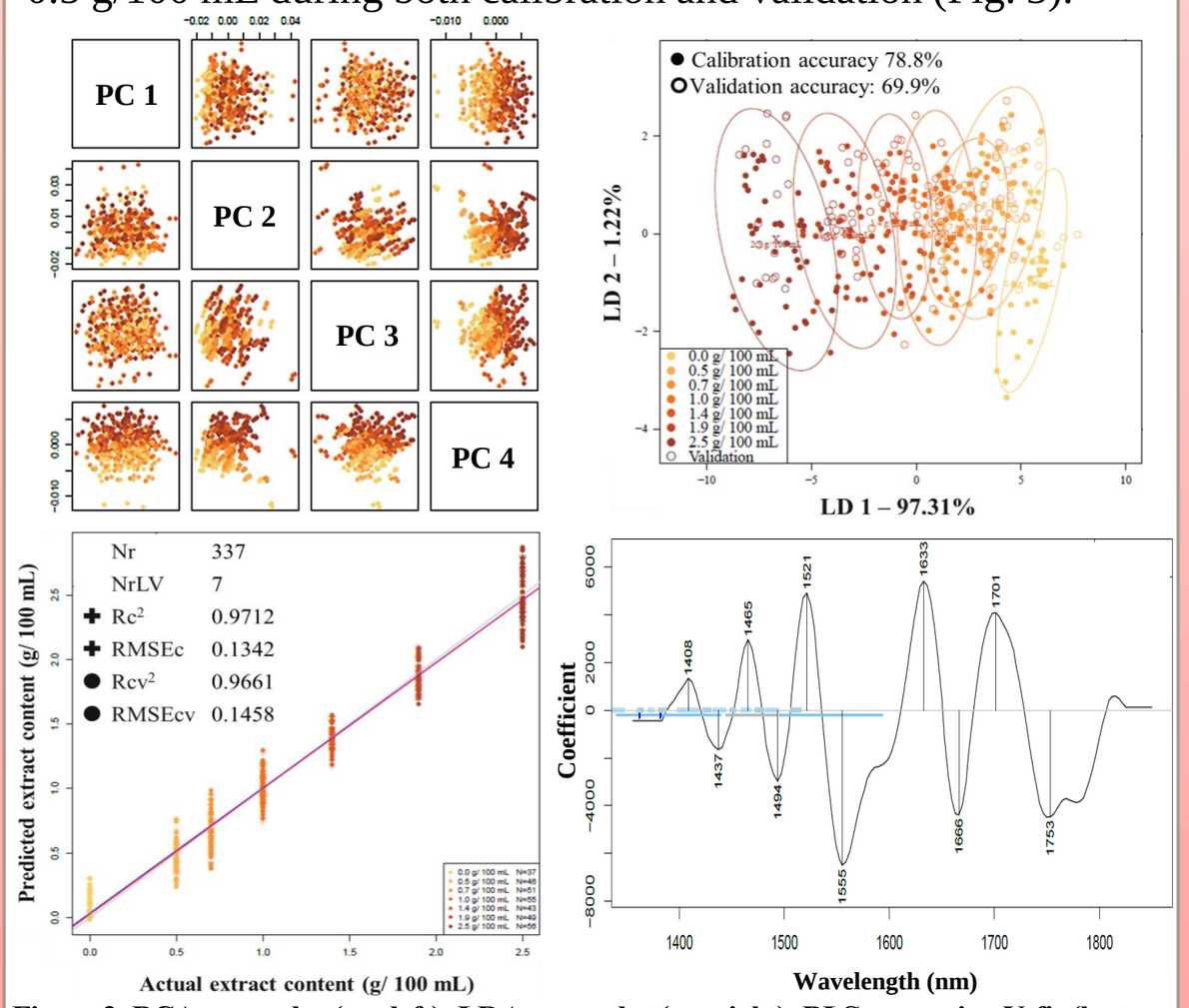

Figure 3. PCA score plot (top left); LDA score plot (top right); PLS regression Y-fit (bottom left); PLS regression vectors according to degree of juice enrichment (bottom right).

Conclusion

The results highlight the potential of NIR spectroscopy as a fast and non-destructive method for monitoring the quality and composition of fortified fruit juices. This technique can support the production of healthier, more transparent beverage options that align with the preferences of health-conscious consumers.

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