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Short communication

Raman spectroscopy analysis of rosehip herbal teas

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Introduction

Dog rose is a wild shrub species growing in temperate to subtropical habitats of Europe, western Asia, Middle East, and North America and northwest part of Africa. The plant was broadly studied for its phytochemical, nutritive and wide range of medicinal properties. The main compounds presented in rosehip fruit responsible for health benefits are carotenoids, mainly lycopene, beta-carotene, zeaxanthin, rubixanthin and the lutein in traces (Al-Yafeai et al., 2018). Carotenoids are natural antioxidants notable for human nutrition since they are precursors of retinol (vitamin A). Numerous studies have shown the relationship between the consumption of carotenoid-rich fruits and vegetables and a lower risk of chronic degenerative diseases, especially cancer (Freedman et al., 2008). Beside carotenoids, there are a many other bioactive compounds that have potentially positive effects on human health, like vitamins, amino acids, organic acids and phenolic compounds (Ercilsi, 2007).

Different traditional analytical methods have been previously used for qualitative and quantitative determination of rosehips carotenoid content, such as TLC (Hornero-Mendez and Mınguez-Mosquera, 2000) and HPLC (Al-Yafeai et al., 2018). These methods usually include long process of sample preparation and use of expensive chemicals, Raman spectroscopy (RS) represents a non-destructive, fast, and non-preparatory technique able to measure sample in several seconds. As a result, spectra are obtained immediately from different types of samples. Spectra are characterized by band position, band intensity and band width (Gierlinger and Schwanninger, 2007).

The aim of this paper is to discriminate different rosehip tea products by application of Raman spectroscopy and chemometrics.

Material and methods

Plant material

Four commercially available tea trademarks (Alloro, Fructus, Yumis and Bravo) of rosehip samples were purchased in the form of tea bags (ingredients: 70% fruit and 30% of rose hip leaf) as processed tea in local Serbian markets.

Raman Instrumentation

Raman spectra of hypanthium parenchyma cells (rosehip fleshy fruit part) were recorded using laser at a wavelength of 532 nm equipped with a 1200 lines/mm grating, spectra were acquired by applying exposure time 10 s and scanning the sample 10 times, using 10% filter. Spectral resolution was about 3 cm^{-1} and calibration was checked by silicon. In order to take possible sample inhomogeneity, for each sample at least ten Raman spectra were recorded. The assignment of major bands was carried out using carotenoid standard (beta-carotene) and literature data.

Statistical analysis

The data were arranged in matrix with 35 rows (objects-samples) and 334 columns (variables-wavenumbersThe PCA was .performed as a standard multivariate tool to reduce the data dimensionality, to

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provide thete relationships between the objects and for grouping them. The method is based on the Pearson correlation matrix and the outputs are consisted of score plot to visualise differencies between samples and to cluster them upon different variables (wavenumbers) Prior to PCA analysis, baseline correction was applied to the spectra. All statistical analysis were performed using Matlab software version 2017a.

Results and discussion

As a result of PCA anaysis, score and loading plots were obteined. First two principal components (PC1 and PC2) described 88.48% of the total data variance. Accordingly, score plot (with first two principal components) displays a good separation between samples.

Examination of loading plot indicated that the highest negative loadings were at 1001, 1152 and 1511 cm^{-1} probably associated to lycopene (Schultz et al., 2006). The main reason for samples separation upon PC1 was most likely connected with drying treatment of tea contributing to lycopene degradation. Anguelova and Werthesen (2000) showed that degradation of lycopene is in relationship with storage time and temperature.

Discrimintion of tea samples upon PC2) showed that Bravo herbal tea differed from Yumis and Fructus tea sample, according to large negative loading at position 1522 cm^{-1}, attributed to carotenes, involving vibration of C=C from polyenic chain (Schulz and Baranska, 2007), in addition to the negative medium intensity at 1160 cm^{-1} assigned to C-O, C-CH vibration of pectin molecules (Szymańska-Chargot et al., 2016). Although rosehips are generally known to contain high levels of health-promoting compounds such as carotenoids, differences between rosehip tea products may be a consequence of different plant origin, as well as differences in postharvest procedures. It is known that carotenoids are very unstable compounds, drying and temperature processes can contribute to its degradation (Shameh et al., 2019).

Conclusion

Results of the present study highlighted the prospective tool of RS and chemometrics for discrimination of different rose hips products. Results based on PC2 gave a good separation between Bravo and Yumis roses hip teas based mainly on carotenoids and cell wall compounds (pectin, cellulose and hemicelulose) and in the lower extend in phenolic compounds. Finally, Raman spectroscopy can be recommended as a good tool for rapid determination of carotenoids in rosehips fruits and teas, as well as in assessment of possible adulteration of products Additional research will be focused on application of Raman spectroscopy for assessment of total and individual carotenoids in different rosehip products.

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