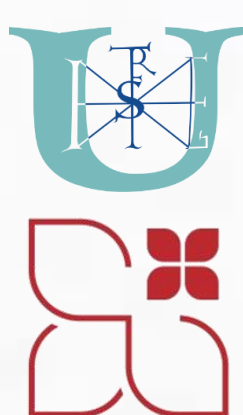


APPLICATION OF NIRS AND AQUAPHOTOMICS FOR THE DETECTION OF ADULTERATION OF HONEY, PAPRIKA AND TOMATO PASTE

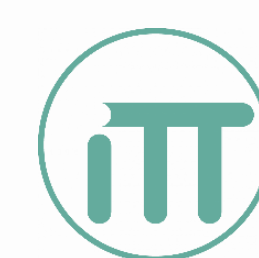


Zsanett Bodor^{1,2*}, John-Lewis Zinia Zaukuu¹, Flóra Vitális¹, Balkis Aouadi¹, Zoltán Gillay¹, Csilla Benedek², Zoltan Kovacs¹

Szent István University, Faculty of Food Science, Department of Physics and Control, Somlói street 14-16. Budapest, H-1118

Semmelweis University, Faculty of Health Sciences, Department of Dietetics and Nutrition, Vas street 17. Budapest, H-1088

*zsanett.bodor93@gmail.com



INTRODUCTION

Over the course of the years, food adulteration has taken many shapes and forms, with the main motive of making profit often regardless of its detrimental effects. The complex nature of some adulterants can outmaneuver detection with conventional methods.

Our aim was to check the applicability of aquaphotomics technique:

- for the detection of **honey** adulteration with syrups,
- paprika powder** with corn flour
- tomato paste** with multiple adulterants: starch, paprika seed, salt and sugar.

MATERIALS AND METHODS

Honey experiment: Linden honey (*Tilia spp.*) was adulterated with rice (RI) or beet syrup (BE) to contain 0.5%, 1%, 2%, 2.5%, 5%, 7.5%, 10%, 15%, 20%, 30%, 40% and 50% of the syrup.

Paprika powder experiment: Authentic paprika powder samples were mixed with corn flour at ten increasing concentration levels: 0%, 1%, 3%, 5%, 10%, 15%, 20%, 25%, 30% and 40%. Mixtures were then diluted 10^1 , 10^2 and 10^3 times with distilled water.

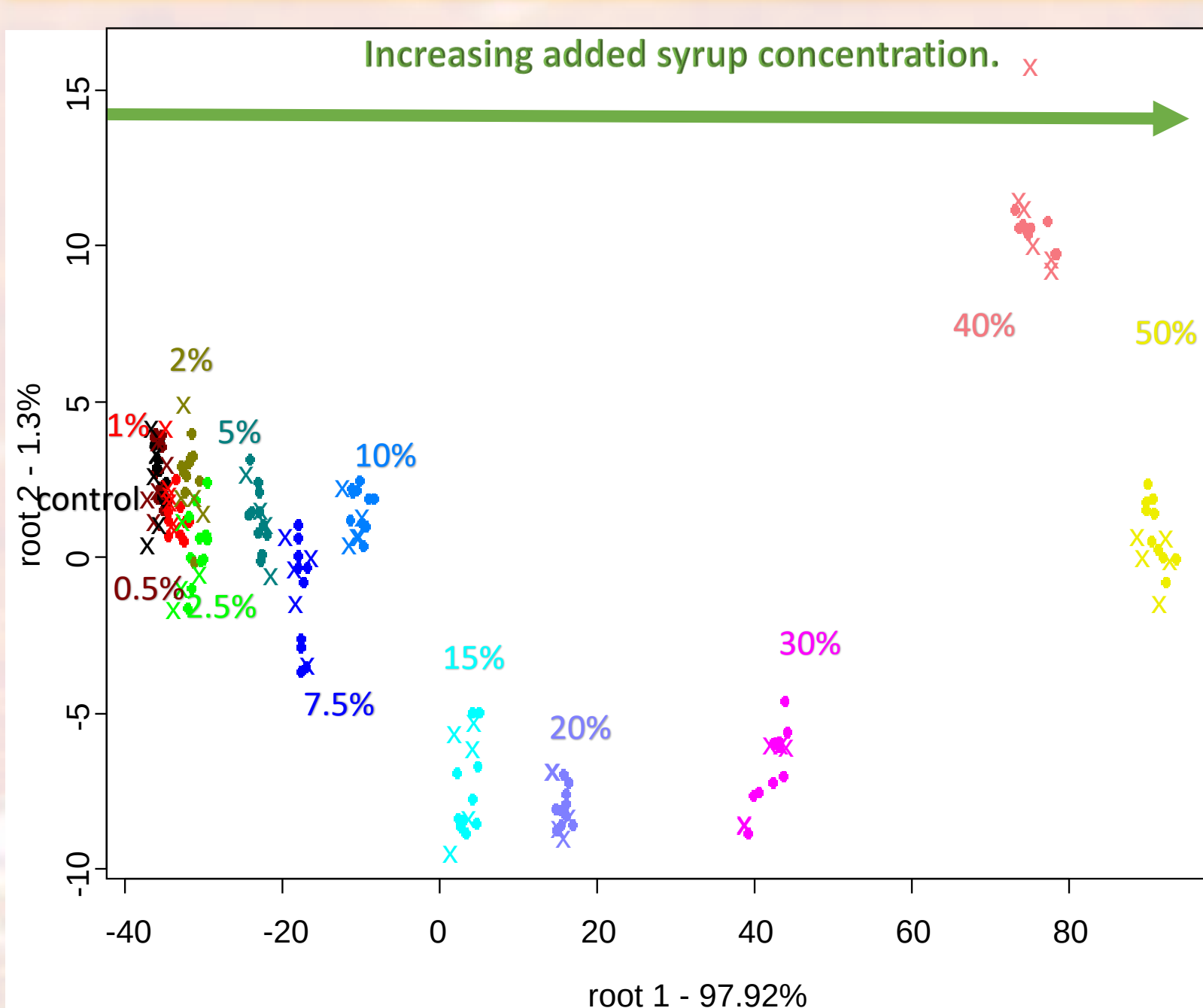
Tomato paste experiment: Tomato concentrates (T) were adulterated with ground paprika seed (P) and starch (K) -0.5, 1, 2, 5, 10% w/w-, sugar (C), salt (S) -0.5, 1, 2, 5% w/w- and with their potential combinations T, C, S, WK, CS, WKC, WKS, WKCS, WP, WPC, WPS, WPCS. Distilled water (W) was added to the samples containing paprika seed powder at specified concentrations.

NIRS measurements: The transmittance spectra of the samples were recorded with MetriNIR spectrometer in the wavelength range of 740 to 1700 nm, for all the sample sets.

Statistical analysis: Principal component analysis (PCA) to check pattern. Linear discriminant analysis (LDA) to build models for the discrimination of levels of adulteration. Partial least square regression to regress on the added adulterant concentration (PLSR). Aquagram was used to visualize changes in spectral patterns as a result of adulteration.

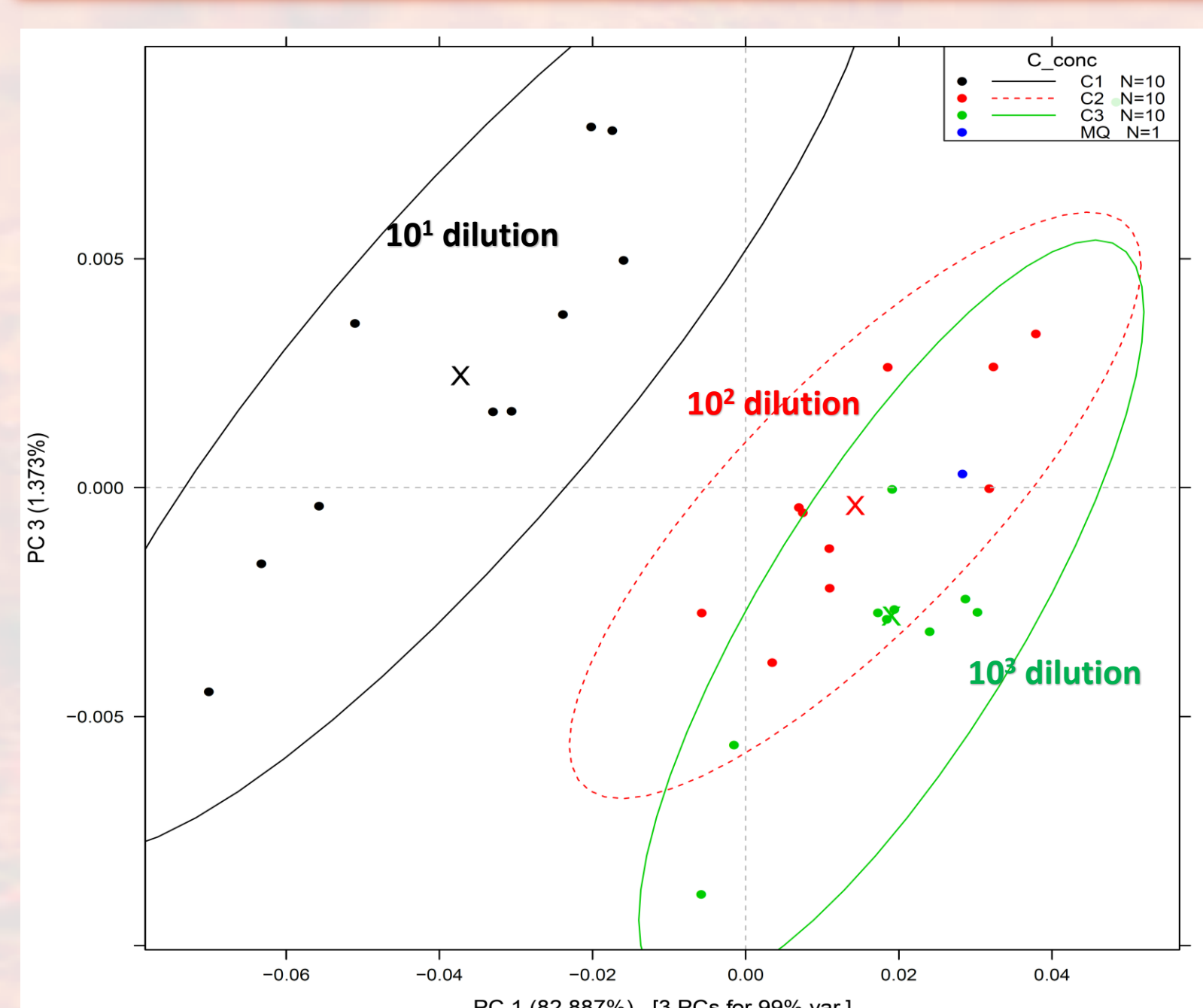
RESULTS

Results of the honey study



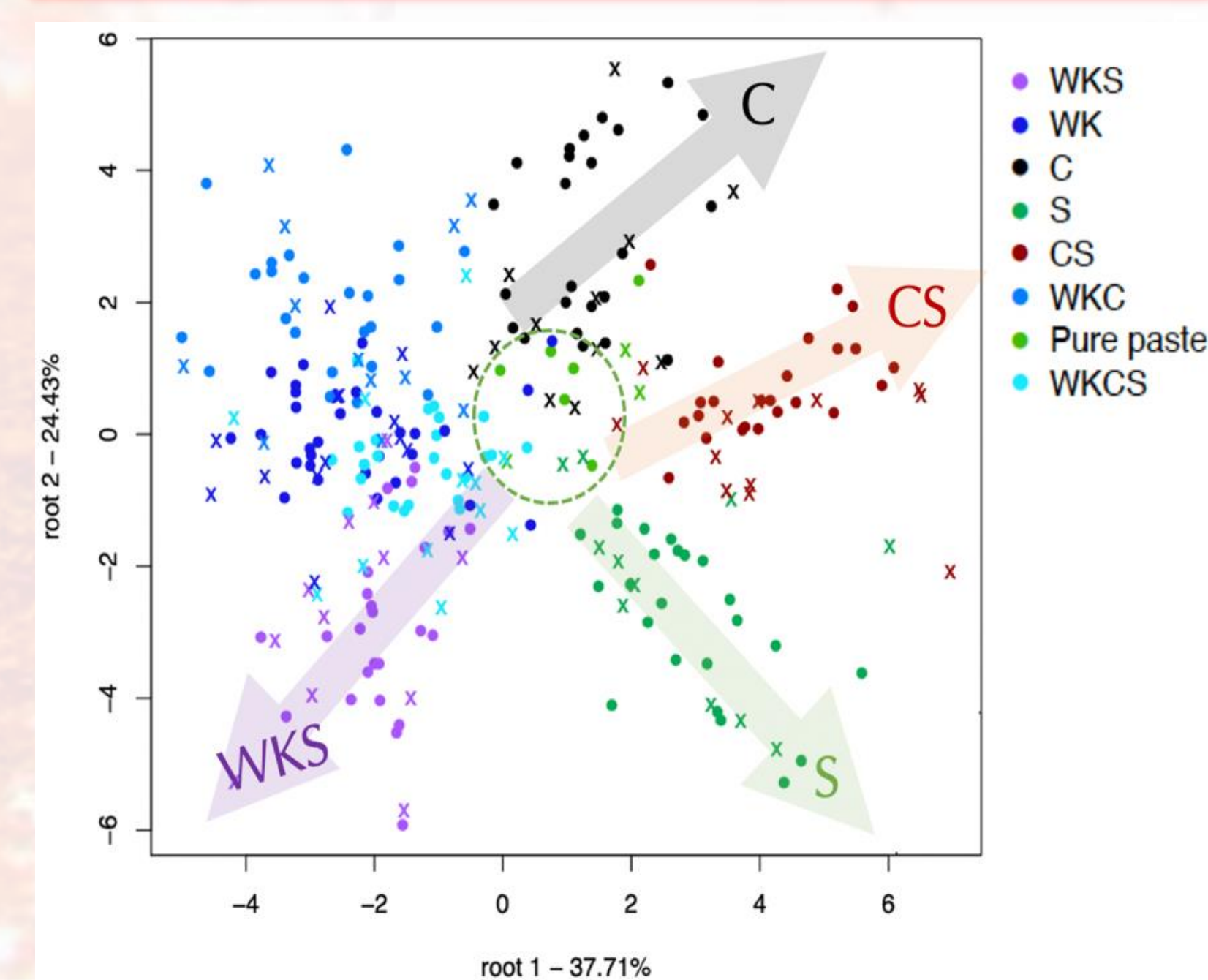
LDA results of the Beet syrup adulterated honey after using the range of 950-1650 nm after Savitzky-Golay smoothing and multiplicative scatter correction

Results of the paprika study

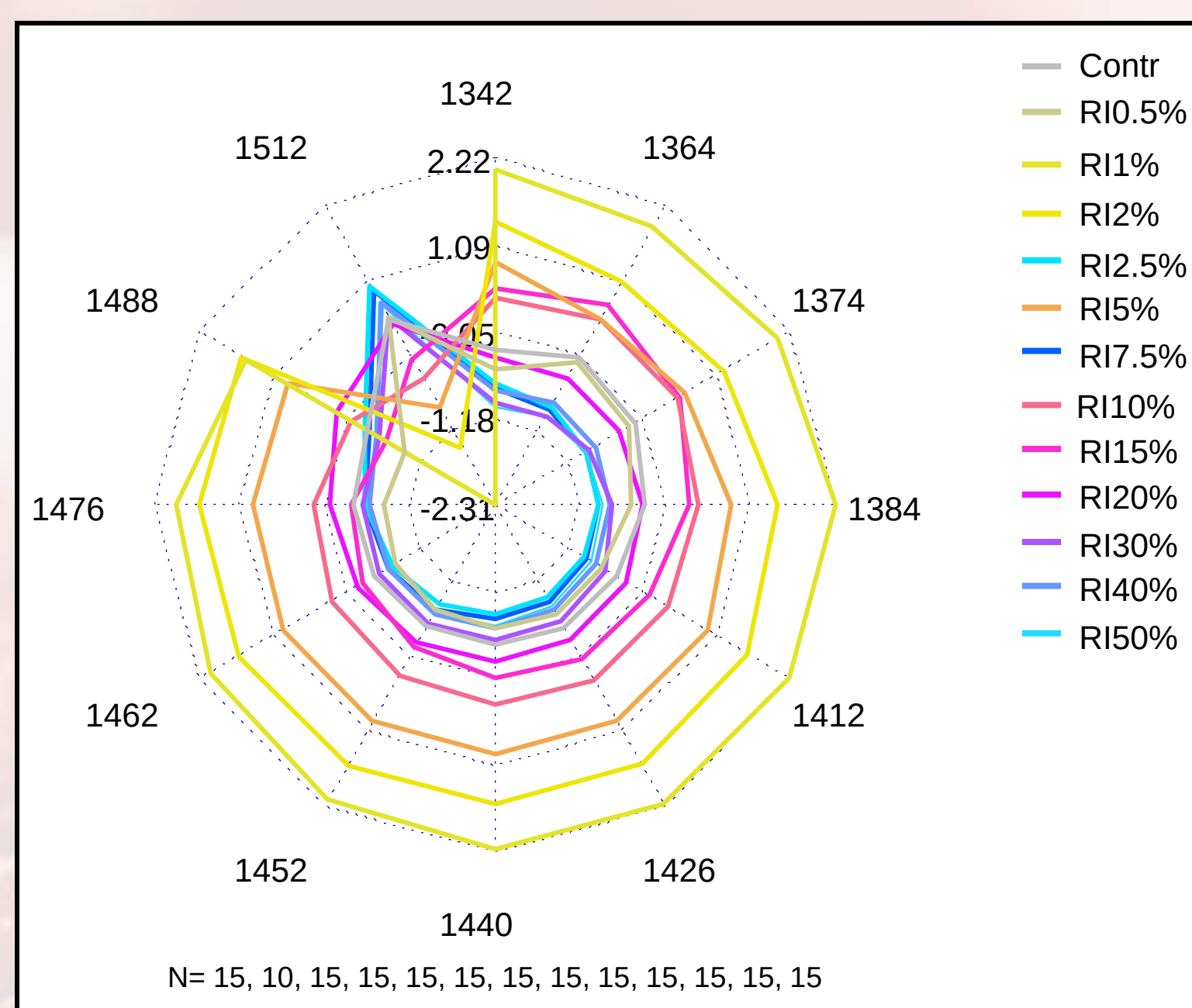


PCA results of averaged NIR spectra (1300-1630 nm) for aqueous solutions of adulterated paprika powder after Savitzky-Golay Smoothing and multiplicative scatter correction and Detrend

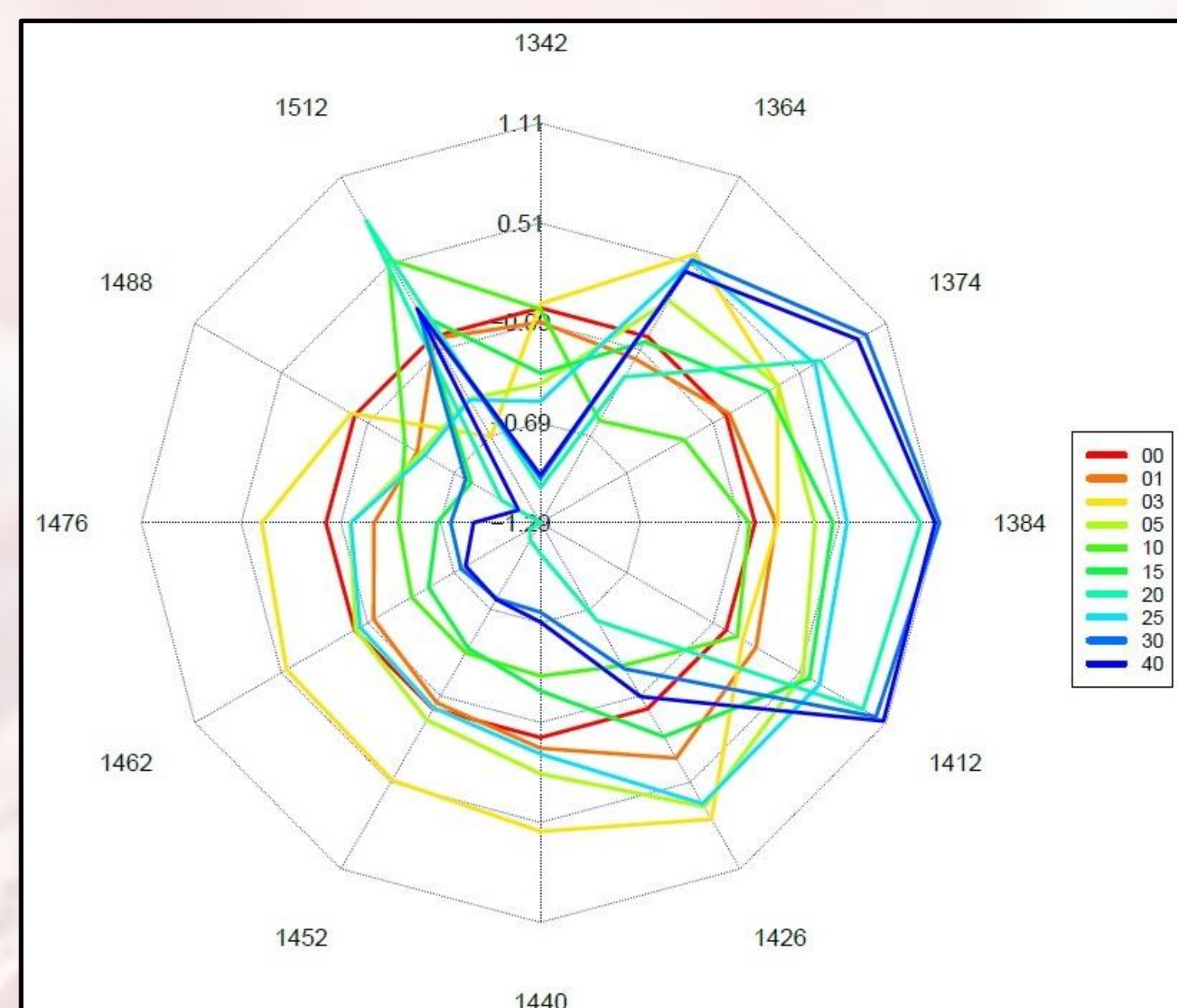
Results of the tomato study



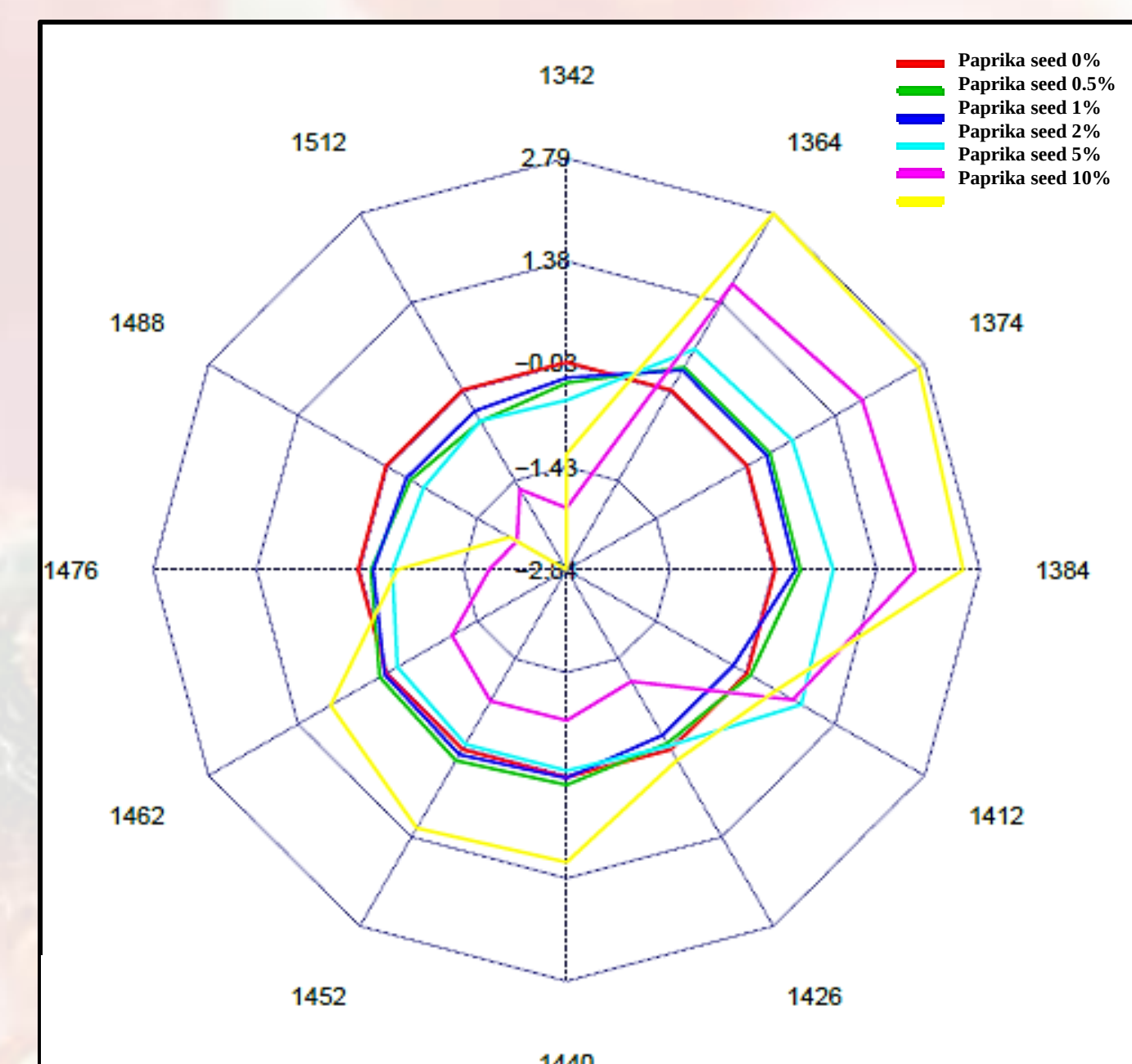
LDA plot of tomato paste concentrates containing single and multiple mixtures of adulterants at five different concentration levels



Aquagram of the rice syrup adulterated honeys



Aquagram of the aqueous solutions of adulterated paprika powder samples



Aquagram of the paprika seed adulterated tomato paste samples

CONCLUSION

Honey experiments provided good results for the detection of honey adulteration with sugar syrup using the range of 950-1650 nm.

The quantification of corn flour in 10^1 diluted **paprika powder** solutions by PLSR regression was also accurate with R^2CV and RMSECV values of 0.85 and 5.02%, respectively. Obtained aquagram showed a distinctive pattern depending mostly on the added corn flour concentrations.

The adulteration of **tomato paste** concentrate with paprika seed power, starch, salt and sugar and could be classified with high recognition (100%) and prediction accuracies (80%-100%) in LDA. Multiple adulterant combinations could also be discriminated in LDA with high accuracies.

Based on the results of the three experiments aquaphotomics and NIRS could be promising methods for uncovering adulteration of different food matrices and quantification of added adulterants.