

Second Aquaphotomics European Conference

BOOK OF ABSTRACTS



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Detection of multiple adulterants in tomato paste using near infrared spectroscopy

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Fast paced living conditions have led to an increasing demand in tomato paste (concentrate). Tomato is a nutritious food product that is suspected to be adulterated with inferior substances for increased profit. The complex nature of some adulterants can outmaneuver detection with conventional methods. Near infrared spectroscopy (NIRS) and aquaphotomics have been used successfully in diverse applications including rapid food evaluation. The study aims to apply NIRS and aquaphotomics to detect and predict low concentrations of ground paprika seed, sugar and salt in tomato concentrates. Authentic tomato concentrates (T) were acquired from a tomato processing plant in Kecskemét, Hungary and adulterated with ground paprika seed (P), sugar (sucrose, C) and salt (sodium chloride, S). Tomato concentrates were falsified according to a matrix encompassing all the potential (suspected) combinations of the adulterants: paprika seed powder (0.5, 1, 2, 5, 10%w/w), sugar and salt (0.5, 1, 2, 5%w/w). There was a total of eight combinations: T, C, S, WP, CS, WPC, WPS, WPCS and 90 adulterated samples (three repeats each) and a control (pure paste). Distilled water (W) was added to the samples containing paprika seed powder at specific concentrations (0.75, 1.5, 3, 7.5, 15%w/w) that were determined based on the tomato paste consistency. The Metri spectrometer (wavelength range of 740 nm - 1700 nm) was used to collect three consecutive transmittance spectra for each sample using a thermoregulated cuvette (0.4 mm layer thickness). The spectra were pretreated with Savitzky-Golay smoothing filter (2nd order polynomial) and multiplicative scatter correction (MSC) in the spectral range 1300 - 1600 nm with R-project. Linear discriminant analysis (LDA) and partial least squares regression (PLSR) were used to classify and predict the adulterants and their concentration levels respectively. Water matrix coordinates (WAMACs) in aquagram were used to visualize changes in spectral pattern as a result of adulteration. The different adulterant combinations were discriminated in LDA with a 91.11% for recognition and 57.99% for prediction. The samples containing paprika seed were discriminated in LDA with an accuracy of 98.89% for recognition and 65.46% for prediction. The LDA prediction accuracy for sugar, salt and water was 71.35%, 95.32% and 77.74% respectively. In PLSR, the concentration of added paprika seed powder could be predicted with an R_{CV}^2 of 0.93 and RMSECV of 0.58 %w/w. Sugar, salt and water were predicted with R_{CV}^2 in the range of 0.92-0.98 and with RMSECV less than 1 %w/w. Aquagram WAMACs showed trends that correlated to adulteration patterns.