

Second Aquaphotomics European Conference

BOOK OF ABSTRACTS



Budapest, 2-3 December 2019

Lurdy International Conference Center

Könyves Kálmán krt. 12-14., 1097 Budapest, Hungary

Szent István University

ISBN 978-963-269-848-9



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Società Italiana di Spettroscopia NIR

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Authentication of tomato paste concentrate with near-infrared spectroscopy

John-Lewis Zinia Zaukuu^{1*}, Flora Vitalis¹, Viktoria Zsom-Muha¹, Balkis Aouadi¹, Zoltan Kovacs¹

¹*Szent István University, Faculty of Food Science, Department of Physics and Control, Somlói street 14-16., 1118 Budapest, Hungary*

**izaukuu@yahoo.com*

Tomato paste is prioritized in many cuisines for many reasons but is recently suspected to be adulterated with inferior substances across the production chain. The cost, high technicality and sensitivity of some conventional methods is a challenge in detecting new trends of adulteration. Near infrared spectroscopy (NIRS) and aquaphotomics provides an approach for rapid monitoring of food quality. The study aimed to apply NIRS to detect and predict low concentrations of starch, salt (NaCl) and sugar (sucrose) tomato concentrates.

Authentic tomato concentrates (T) were acquired from a tomato processing plant in Kecskemét, Hungary and adulterated with starch (K), sugar (C) and salt (S). Tomato concentrates were falsified according to a matrix encompassing all the potential (suspected) combinations of the adulterants: starch (0.5%, 1%, 2%, 5%, 10%), sugar (0.5%, 1%, 2%, 5%) and salt (0.5%, 1%, 2%, 5%). There was a total of eight combinations: T, C, S, WK, CS, WKC, WKS, WKCS with some samples containing multiple adulterants. Distilled water (W) was added to the samples containing starch to maintain predetermined consistencies. In all, 90 adulterated samples (three repeats each) and a control were randomly scanned with the Metri Spectrometer (wavelength range of 740nm- 1700nm) for three consecutive transmittance spectra of each sample using a thermoregulated cuvette with 0.4mm layer thickness. Savitzky-Golay smoothing filter (2nd order polynomial) and multiplicative scatter correction (MSC) pretreatments were applied in the 2nd overtone range of water (1300-1600 nm) using 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 caused by adulteration.

Multiple adulterant combinations were discriminated in LDA with 91.5% accuracy for recognition and 64.2% for prediction. Samples with starch, salt, sugar and water had LDA prediction accuracies of 71.6%, 90.1%, 64.1% and 80% respectively. In PLSR, samples with starch, salt, sugar and water were predicted with R²CV's in the range of 0.88-0.97 and RMSECV less than 1% w/w. Salt in tomato had the best prediction accuracy in LDA and PLSR. Aquagram results showed specific trends of changes in WAMACS relating to the type and level of adulteration.