



Characteristic fingerprints of adulterated tomato: alternative tools of rapid authentication

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Introduction

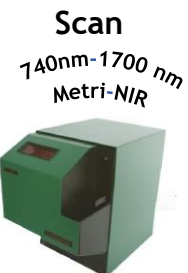
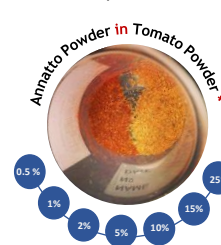
- Economic incentives, coupled with highly sophisticated fraudulent practices continue to raise concerns over food security.
- As an indispensable ingredient to cuisines around the world, tomato powder is amongst susceptible targets of profit-driven fraud.
- Near infrared (NIR)-based evaluation of tomato powder adulteration can be a comparatively rapid alternative to conventional authentication tools.
- Our study aims to pinpoint NIR-spectral fingerprints of Annatto-adulterated tomato powders.

Materials and Methods

Tomato Varieties



Mix



Analyze

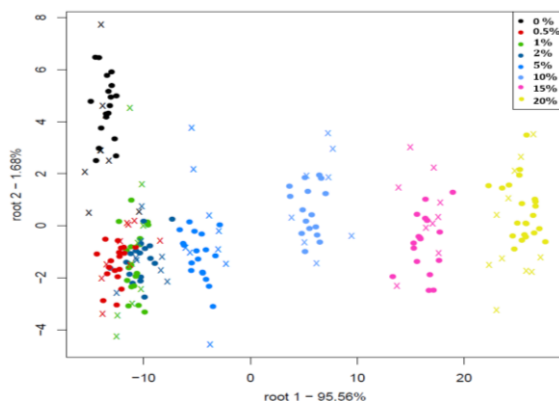


* Prepare in Triplicate, Total Sample Number = 63 mixture + 12 Controls

* SG : Savitzky-Golay Smoothing *SNV: Standard Normal Variate **PCA: Principal Component Analysis **LDA : Linear Discriminant Analysis **PLSR: Partial Least Squares Regression

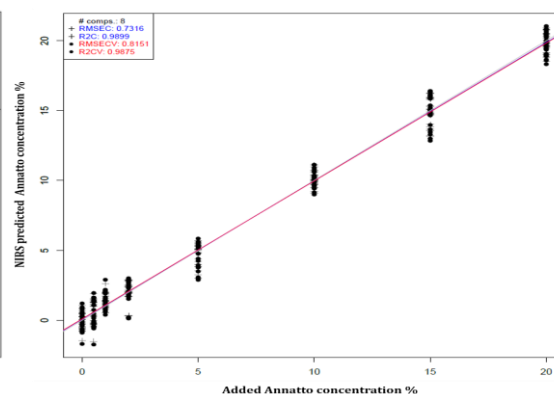
Results

Linear Discriminant Analysis



Classification plot of Annatto-adulterated tomato powders by adulteration levels, Spectral pre-processing: SG

Partial Least Squares Regression



Y-fit graph of the prediction of Annatto concentration in adulterated tomato powder samples. Spectral pre-processing: SG+SNV. Cross-validation: ten-fold CV

- LDA was proven effective when applied to classify the Annatto-adulterated tomato powders depending on their adulteration levels. This translated into 100% recognition and 91.0 % prediction accuracies, irrespective of the varieties. This is depicted in Figure 1 where a pattern of separation could be identified. Misclassifications were observed only between the 0.5%, 1% and 2% Annatto-containing powders.
- In quantifying the added Annatto powder by means of PLSR, the cross-validated models enabled an accurate determination of the different levels of adulteration with R²CV and RMSECV values of 0.98 and 0.81 g/100 g, respectively.

Conclusion

Multivariate assessment with LDA and PLSR showed that near infrared (NIR)-based evaluation of the tomato samples could detect differences of authenticity as well as quantify the varying levels of adulteration with Annatto (0.5%, 1%, 2%, 5%, 10%, 15% and 20%). With LDA prediction rate of 92.68% and PLSR coefficient of cross-validation (R²CV) of 0.98 and Root Mean Square Error of cross-validation (RMSECV) of 0.81 (g/100 g), we can attest to the adequacy of the applied method for rapid authentication purposes.