21. Triennial Conference of the European Association for Potato Research; Kraków, Poland; 2022.07.04-08

Prediction of acrylamide formation in French fries with near-infrared spectroscopy (NIRS)

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In Germany a share of 60% of potato consumption are processed potatoes such as fried products like French fries. While final-frying is mainly done in canteens or at home, industrial processing of par-fried French fries includes raw material inspection and quality control, blanching, par-frying and freezing. Acrylamide can be formed in French fries during final-frying depending on the precursor content, reducing sugars (glucose, fructose) and asparagine. Acrylamide formation is accompanied by browning of the French fries' crust. Breeding goals of potato cultivars for frying purpose include high starch and dry matter contents, good suitability for long term storage and low tendency to synthesize reducing sugars. Due to extensive sample number an exact laboratory analysis of acrylamide in French fries or its precursors in tubers is difficult to implement in the breeding process. Yet, good near-infrared spectroscopy (NIRS) predictions of dry matter and starch content have been established for potatoes. Being minor components of tubers and end products, exact predictions for reducing sugars and acrylamide are hardly reachable with NIRS. In the current investigation, applicability of NIRS as a screening tool in identifying potato genotypes with low potential for acrylamide formation in the breeding process was tested. A set of 185 genotypes from different breeding programs was grown in contrasting environments (Germany, Turkey) over two consecutive years. According to the colour of the French fries after frying most suitable samples for model development were selected resulting in a high variation within the target data set.Modified partial least squares (PLS) procedure was performed on the final dataset of 644 samples. After scatter correction and internal cross validation, data were divided into calibration and validation sample sets for calculating an external validation. We confirmed NIRS to be well suited for prediction of major potato components. As expected, the predictability for minor components was worse. However, mathematical pre-treatments, such as application of first and second derivatives on original spectra were able to improve the model indices for reducing sugars and acrylamide. By applying the calculated NIRS calibration to the validation

data set, up to 90 % of samples were correctly categorized as below or above the guideline value for acrylamide in French fries. Modelling of the large and diverse data set indicates the potential of NIRS technique as a predictive tool in the breeding process for low acrylamide formation.

Keywords

Near-infrared spectroscopy, breeding, processing, contaminants, deep-fat frying

Conference Topics

Processing (old & new products, nutrition)
Eventually: New techniques & hybrid breeding