01-04 Application of NIR technology to predict minor components in raw and processed potatoes

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Being a staple food potatoes are grown in many countries with a world-wide production of 380 Mio tonnes in 2014 [1]. In Germany the per capita consumption of potatoes is about 56.8 kg in the financial year 2015/2016 with a share of 60% of processed potatoes [2] such as fried products (e.g. French fries). Industrial processing of French fries includes several steps like quality control of raw material, blanching, par-frying and freezing [3]. End-frying as the last preparation step is mainly done in canteens or at home. In fried products the heat-induced contaminant acrylamide can be formed via the Maillard reaction depending on the amount of the precursors reducing sugars (glucose, fructose) and asparagine [4].

Different NIRS applications have been tested for potatoes during the last decades. Good predictions of the dry matter and starch content have been established by measuring the raw grounded tuber [5]. Potato cultivars used for processing of French fries usually contain a high amount of dry matter that mainly consists of starch. Due to their low concentration, reducing sugars in the raw tuber (3-24 mmol/kg) and likewise, the acrylamide in the deep fat fried product are minor components [4]. NIRS-based predictions of reducing sugars in the raw material would be an advantage in the quality control of industrial French fries processing [5]. However, acceptable predictions for such minor components are hardly reachable [5,6]. Nonetheless, in potato breeding process less exact predictions could be a useful complementation in the phenotyping of new breeding lines.

Within a current project (DEPOLA, starting 2017) we try to develop a NIRS model to be used as a valid screening tool in identifying potato genotypes with a low acrylamide potential. To perform the trial, a set of 185 genotypes from German and Turkish breeding programs is grown in both countries of contrasting climatic conditions. The total sample number will reach at the projects end 1600 including field replications, several locations (three per country) and different storage treatments. Yet, a subset of 96 samples is analyzed. The quality parameters that were used for model development are dry matter, starch, glucose, fructose, sucrose, colour (*L*a*b** values) and acrylamide. NIR measurement was repeated twice for each sample and a wavelength range of about 400-2500 nm was monitored with a FOSS XDS NIR spectrophotometer.

Most quality parameters show a high variation within the data set, especially for acrylamide but also for the colour (*a** value) and the glucose content, which is a basic requirement. Taking into account the size of the sample set a cross validation was performed. Besides, using non-treated spectra that seem to be well suited for the dry matter content (R^2 of calibration and prediction of 0.97 and 0.96, respectively), the first and second derivatives were used to model the prediction of the minor components. For glucose the R^2 of calibration and prediction were 0.85 and 0.59 when using the first derivative. By using the second derivative for acrylamide the R^2 of calibration and prediction were 0.91 and 0.41. The mathematical pre-treatments were able to improve the model indices. Even though the data set was small, it indicates capabilities of NIR technique as a screening tool for breeding purposes. Satisfactory information should be taken from a larger data set that we will gain by the end of the project in 2020.

References

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