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Inline Raman Spectroscopy for Characterization of an Industrial Poultry Raw Material Stream

Raman spectroscopy is a promising spectroscopic technique for in-line food analysis, with the advantage that both gross components, including fat, proteins and bone, can be targeted at the same time as more detailed information on protein composition, e.g. the concentration of collagen. However, food matrices are generally heterogeneous, and the lack of appropriate tools for addressing sample heterogeneity has traditionally been one of the main challenges preventing the widespread use of this technique in food analysis. One of the milestones in representative Raman analysis has been the development of wide area illumination (WAI) Raman probes. Here, a loosely focused laser beam is used to illuminate a larger area within the sample. The technique has found a range of applications within pharmaceutical, biomedical and chemical analysis, but surprisingly, WAI Raman has not been frequently used in food analysis. In recent years we have shown how the WAI Raman can be used to provide reliable quantitative information from samples that traditionally have been regarded as challenging in a Raman setting, from whole salmon and meat to chicken carcasses, salmon by-products and fruits like apples and strawberries. Recently, we tested the technique for measurements of a heterogeneous poultry raw material stream in a true in-line setting [5]. This work is the focus of the presentation.

In recent years, the poultry processing industry have adopted enzymatic protein hydrolysis (EPH) as a strategy to recover constituents from by-products (e.g. carcasses and mechanical deboning residues). In this process, proteins from the by-products are digested and solubilized by proteases. Today, recovered constituents from EPH usually end up as lower value feed ingredients (used for e.g. pet food), but the focus has been shifting towards protein ingredients for higher-paying markets like human consumption. This puts increasing emphasis on protein quality (e.g. producing protein hydrolysates with specific functional or nutritional properties), and not only on protein recovery. This motivates in-line measurements of the raw materials input to the hydrolysis, which could provide the means for real time process control, potentially leading to better raw material utilization (less waste of food resources) and help prevent batches of hydrolysates being discarded from the human market. The main aim of the present study was to test in-line Raman spectroscopy for characterisation of an industrial poultry raw material stream. In the work, calibrations based on Raman measurements of fat, protein, ash (proxy for bone) and hydroxyproline (proxy for collagen) in ground poultry rest raw material were established. Subsequently, the obtained calibrations were tested for continuous monitoring of a ground poultry by-product stream at a commercial hydrolysis facility over the course of two days. To the best of our knowledge, this is the first time a WAI Raman probe has been tested in-line under relevant measurement conditions in the food industry.

References

[1] T.A. Lintvedt, P.V. Andersen, N.K. Afseth, J.P. Wold, Talanta. 266 (2024) 125079.