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NIR as a tool for optimising sampling time and studying batch dynamics.

Joanna Zeppelin

Innovation and Environmental Affairs, Arla Foods amba, Roerdrumvej 2, 8220 Brabrand, Denmark

The paper presented here is the initial part of a larger study, in which it was determined which quality parameters in cheese powder could already be predicted by NIR at an early stage in the process and which could only be predicted at the final stages of the process. This initial study was performed in order to establish the levels and nature of variation within and between batches such that the subsequent data collection could be tackled optimally. The perspectives evolved into more than was originally planned and revealed some interesting uses of NIR-technology.

Cheese powder production starts as a batch process, where waste cheese from other dairies is melted down in a vat. The process then turns into a continual process as the vat is emptied and the melted cheese is then filtered, homogenised, pasteurised and finally spray dried. Between each batch the powder is to a greater or lesser degree a mixture of 2 batches.

This paper is divided into 2 aspects, one regarding the optimisation of sampling time and the other is a study of process dynamics.

Optimising sampling time

This initial study included 9 powder samples from 9 different batches produced during one day. The raw materials for the batches were chosen with the aim of creating a relatively high level of variation in the data. The total of 81 samples were taken out at regular intervals and spectra were collected on a NIR-systems 6500 instrument. The subsequent reduction of the data by PCA to score values shows the power of NIR as a tool to determine not only when samples are representative of a certain batch, but also which batches are stable enough to include in a further study.

Studying process dynamics

To take this experiment a step further 7 of the 81 samples were sent to the laboratory for further analyses. The samples were chosen on the criteria that they covered the spectral variation in the dataset. These samples were analysed for 4 chemical components and 5 physical attributes, which are essential for describing the quality of the product.

The latent structure of the 7 samples, using the chemical and physical variables, is totally comparable to the latent structure of the NIR spectra. This outcome makes it possible to describe the dynamics of one day's production both chemically and physically with relatively little resources.

Additionally it raises the question as to whether reference values are needed, as the latent structure of the NIR-spectra appears to be sufficient in providing information on the quality of the product. To be able to use NIR in this way would require defining quality limits in the principal component space as opposed to each of the reference values.

The potential of NIR applied in an explorative fashion with batch processes opens a whole new gateway for the use of this technology. This study explains yet again after so many years in the field "why I'm crazy about NIR!"