A classical spectroscopic approach to food process control

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Introduction

Near infrared (NIR) compositional analysis is widely used in food process control and calibration is accomplished using the usual chemometric approaches. In this paper, we describe two different applications in which both the system and the property under study are more complex than for analysis of composition. However, in both cases, a simple classical approach to data processing, without the use of a reference method, has been successful.

Monitoring dough development

The aim was to monitor dough mixing in order to identify the optimum mixing time. The key to the success of this application was very fast data acquisition. Therefore, the Perten DA-7000 Diode Array Spectrometer was used either, as a remote sensor or via a fibre optic probe, inserted into the side of the

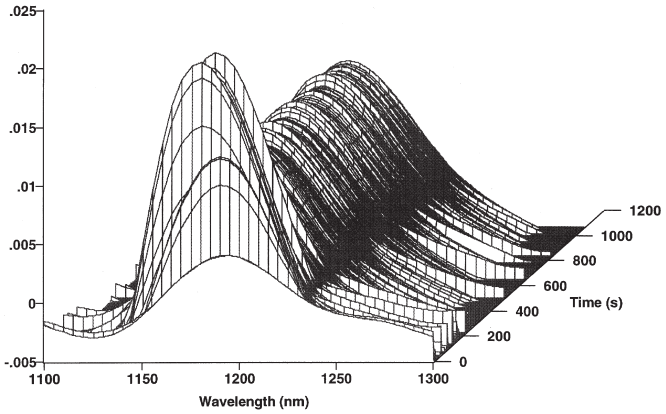

Figure 1. 2nd derivative spectra of dough recorded during mixing.

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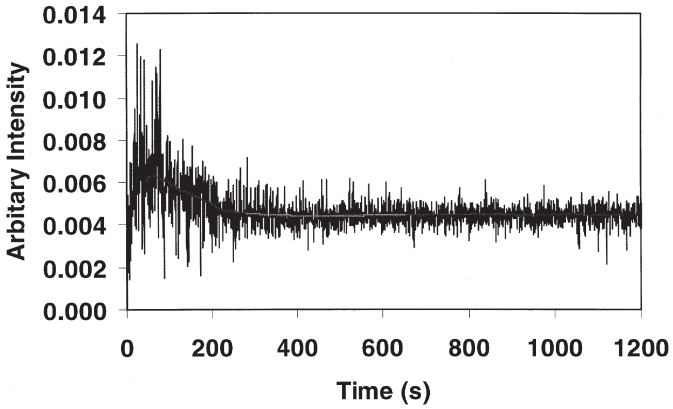

Figure 2. Mixing curve extracted from NIR data.

mixer. It was found that the area under a second derviative peak at 1160 nm decreased, then increased again, as dough mixing progressed (Figures 1 and 2). It was shown by substitution of the water in the dough formula with D_2O that this band is due to water, so the NIR probe is following changes in the state of water in the dough.[1]

Monitoring degree of cook in starch

The aim was to monitor changes in starch structure, referred to as "degree of cook", during extrusion cooking. In this case, the sample is a hot fluid under elevated pressure. The measurement was made at a point in the process where, essentially, no further processing was taking place using a Process Analytics Analyzer (on-line NIRSystems 6500) fitted with paired fibre optic transmittance probes. The depolymerisation of starch, as processing conditions became more severe, could be followed by a straightforward peak height measurement at the second derivative maximum of a band as-

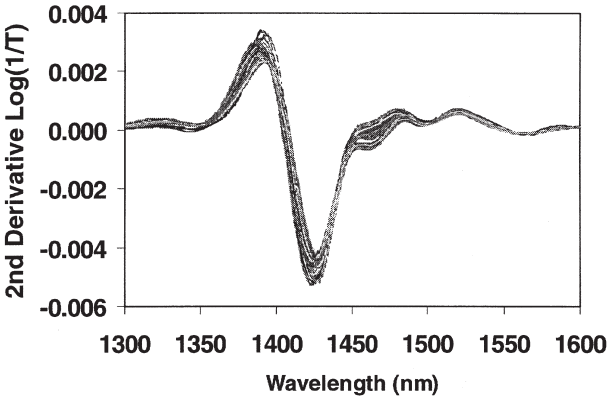

Figure 3. Second derivative spectra of molten starch in extruder.

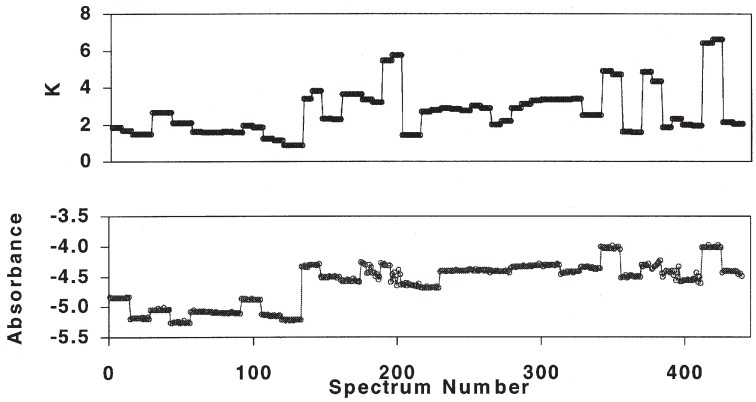

Figure 4. Control chart showing variation in degree of cook (k) and absorbance at 1430 nm.

signed to the first overtone of free O–H (Figure 3). Plotting this value against time on a control chart enabled the degree of cook to be monitored in real time (Figure 4).[2]

Conclusions

We have shown that a classical spectroscopic approach can be used in the analysis of near infrared data to obtain information from two different food processing systems. In both cases, a single measurement, made on the second derivative spectrum, provides a mechanism for following the progress of the system.

Acknowledgement

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References

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2. A. Evans, S. Huang, B.G. Osborne, Z. Kotwal and I.J. Wesley, *J. Near Infrared Spectrosc.* **7,** 77 (1999).