

APPLICATION NOTE – CHOCOLATE

Introduction

The production of chocolate is optimised by regulating the fat content in the product. Normally this measurement is done by traditional laboratory methods (extraction with ether) that can be cumbersome, expensive and require trained personnel. Most importantly, these methods are much too slow to allow sufficient reaction time for control of the process. As a result, NIR analysers have replaced most of the traditional methods. These analysers can be placed directly in the production area close to the production line and can be operated by plant personnel. The analysis time is less than two minutes.

The analyser



Figure 1: The QFA focus

The QFA focus is an FT•NIR analyser. Samples are measured over a 5 mm pathlength along a 15 cm strip at the bottom of a plastic bag. The bag contains approximately 100 g of product. A large detector is located directly after the sampling accessory in order to intercept a significant proportion of the diffusely transmitted light. The large sample area averages the sample heterogeneity, thus improving the repeatability of the measurement.

The QFA focus uses economical, disposable, plastic bags for sampling. The plastic bag is easily filled with melted chocolate by the operator and inserted directly into the accessory for analysis.

Calibration

Chocolate samples were taken directly from the production and measured 6 times at different temperatures.

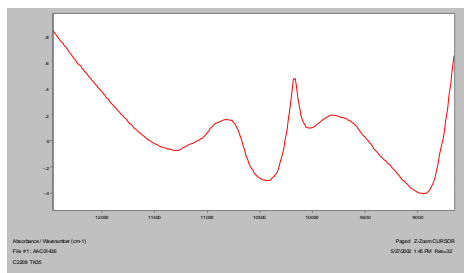


Figure 2: Typical FT•NIR spectrum of chocolate.

The NIR region contains both combination and overtone information. The most sensitive bands are those derived from the O-H and C-H stretch regions. In order to compensate for pathlength changes due to scattering effects from the sample and pathlength differences derived from the disposable plastic bags, all spectra were pre-processed using baseline correction, thickness correction and mean centring.

The calibration sets contained different recipes of dark chocolate, milk chocolate and nougat respectively. The calibration samples were collected directly from the production lines to ensure that they were based on the reality. The samples were measured at different temperatures to ensure a solid calibration working in the actual temperature range. A Partial Least Squares (PLS) model was developed based on the analytical and spectral data.

Calibration Performances

Table 1 shows the performance of the calibrations. Each sample was analysed in duplicate by a research laboratory. The chocolate and nougat calibrations contain more than 100 spectra, each measured in a temperature range of 40 to 70 °C.

Property	Range %	NIR SECV	Reference Method RMSD	Repeatability
Fat				
Dark chocolate	28 - 38	0.28	0.06	0.06
Milk chocolate	23 - 36	0.20	0.06	0.04
Nougat	28 - 43	0.18	0.06	0.06

Table 1: Performance of the calibrations for fat in dark chocolate, milk chocolate and nougat.

The calibrations were validated using a number of samples that were not included in the calibration. The Standard Error of Prediction (SEP) was reported as being 0.28 for fat in dark chocolate, 0.17 for fat in milk chocolate and 0.17 for fat in nougat.

Conclusion

The QFA focus is suitable for use in the plant. It is intended to be placed near the production line and measures fat in dark chocolate, milk chocolate and nougat. Plant personnel can do sampling and analysis. The calibration is independent of temperature variations in the process in the area of 40 to 70 °C.