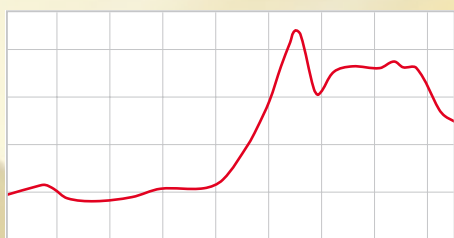


# Application Note

## Butter and Margarine



## Introduction

Law regulates moisture and fat content in butter. To maximize profit, the final product must be as close to the legislated values as possible. Traditional laboratory methods 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 churn and can be operated by plant personnel. The analysis time is less than two minutes.

## Analyser: The QFAfocus

The QFAfocus is an FT-NIR analyser. Samples are measured over a 1.5 cm path length along a 15 cm strip at the bottom of a plastic bag. The bag contains approximately 100 g of butter. 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 and improves the repeatability of the measurement.

The QFAfocus uses economical, disposable, plastic bags for sampling. The operator can easily fill the plastic bag with butter and insert it directly into the accessory for analysis.

## Calibration

The QFAfocus is calibrated against certified methods, modified Kohman for determination of water, fat and salt.

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. Salt cannot be measured directly with NIR, but it causes a change in the shape of the water band and this in turn allows for determining the salt content. To compensate for path length changes due to scattering effects from the sample and path length differences derived from the disposable plastic bags, all spectra were pre-processed using normalisation, baseline correction and mean centring.

The calibration samples were designed to ensure that the extremes of moisture and fat content were included in the set. The calibration set contained butter with and without colouring agents. A Partial Least Squares (PLS) model was developed based on the analytical and spectral data.

## Calibration Performances, Example

Table 1 shows the performance of the calibrations. Each sample was analysed in duplicate by a research laboratory. The butter calibrations contain over 150 spectra. These calibrations support the presence of colouring agents and temperature variations of the process, normally between 13 and 30 °C. Repeatability of the method was determined by analysing 10 samples drawn from the same lot.

Property	Range %	NIR SECV	Ref. Method RMSD	NIR Repeatability
Butter, Fat	80-83	0.10	0.08	0.03
Butter, Moisture	13-18	0.10	0.08	0.03
Margarine, Moisture	19-24	0.19	NA	NA
Butter & Margarine, Salt	0.5-2	0.05	NA	0.01

Table 1: Performance of the QFAfocus

The calibrations were validated using a number of samples that were not included in the calibration. The Standard Error of Prediction (SEP) was reported being 0.10% for fat and 0.09% for moisture.

## Conclusion

The QFAfocus is suitable for use in the plant. It is intended to be placed near the butter churn and measures moisture, fat and salt. Plant personnel can do sampling and analysis. The calibration is independent of temperature variations in the process and the presence of colouring agents. The QFAfocus can be used as a turnkey system without any further calibration development. If a smaller error is needed, analysing samples collected from the plant and implementing discrimination functions would further optimise the method.

**Q-Interline A/S**  
Københavnsvej 261  
DK-4000 Roskilde

Phone: +45 4675 7046  
Fax: +45 4675 7096  
E-mail: [info@q-interline.com](mailto:info@q-interline.com)  
Web: [www.q-interline.com](http://www.q-interline.com)

