Briefing Note

KEIT spectrometers

Industrial analyser for monitoring composition of **milk & dairy products** in production

Introduction

Modern milk production is a highly advanced and automated process – with substantial control over the product and physical processes. These are designed to take a variable input (the raw milk itself) and create a standard product with repeatable, reliable and high quality properties. There are advanced technologies mostly built on near-infrared (NIR) spectroscopy now available for on-line and continuous measurement of milk products. For basic applications NIR instruments perform very well, able to measure a wide range of chemical constituents. But as requirements become more stringent and process technologies and opportunities require increasingly more accurate and precise instrumentation, NIR spectroscopy has only limited scope and use.

What's the solution?

NIR is fundamentally restricted by the underlying physics of the spectroscopy. It only looks at "overtones" and "combination bands" of molecules – similarly to looking a person's shadow rather than their face to identify them. Mid-infrared FTIR spectroscopy observes the fundamental vibrations of molecules instead. It gives significantly more information and better performance than NIR instruments. However, traditional FTIR instruments are fragile and not suited for process measurements.

The IRmadillo is a static-optics FTIR spectrometer, specifically designed for robustness and reliability. This combines the process-ready robustness of NIR instruments with the performance of a laboratory FTIR: the best of both worlds.

What applications can it measure?

The IRmadillo can be calibrated to measure a wide range of chemicals simultaneously, including:

- Protein levels and different protein types
- Lactose and other sugars
- Urea
- Fats
- Total solids (TS)
- Solids non-fat (SNF)
- Somatic cell count (SCC)

The IRmadillo can also run qualitative calibrations to indicate different states - for example, "contamination detection". This gives additional confidence that the final product will be suitable and pass quality control (QC) checks, reducing the risk of product loss if a problem does occur.

The following graph shows an example set of calibration spectra for varying protein levels. The differences between the spectra can be clearly seen by eye – this simply isn't possible with an NIR instrument!

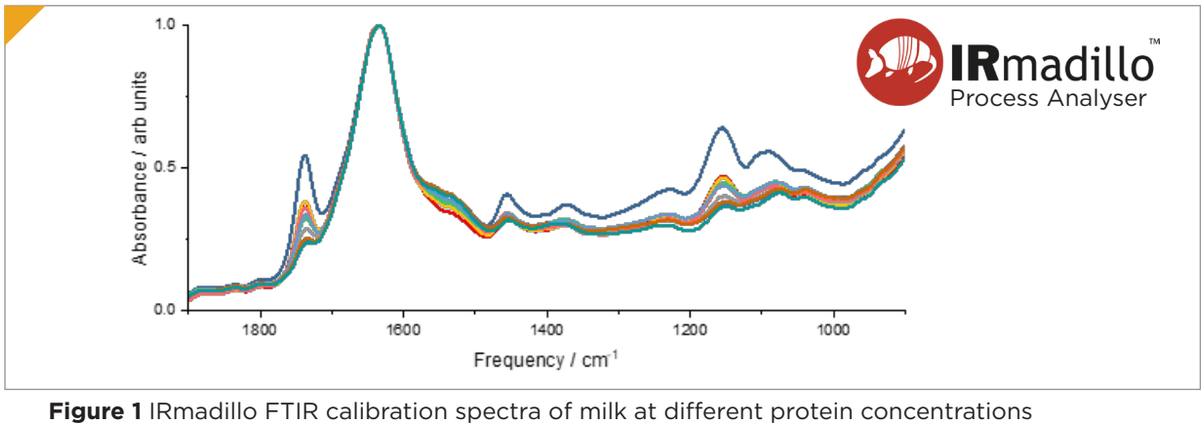

Figure 1 IRmadillo FTIR calibration spectra of milk at different protein concentrations

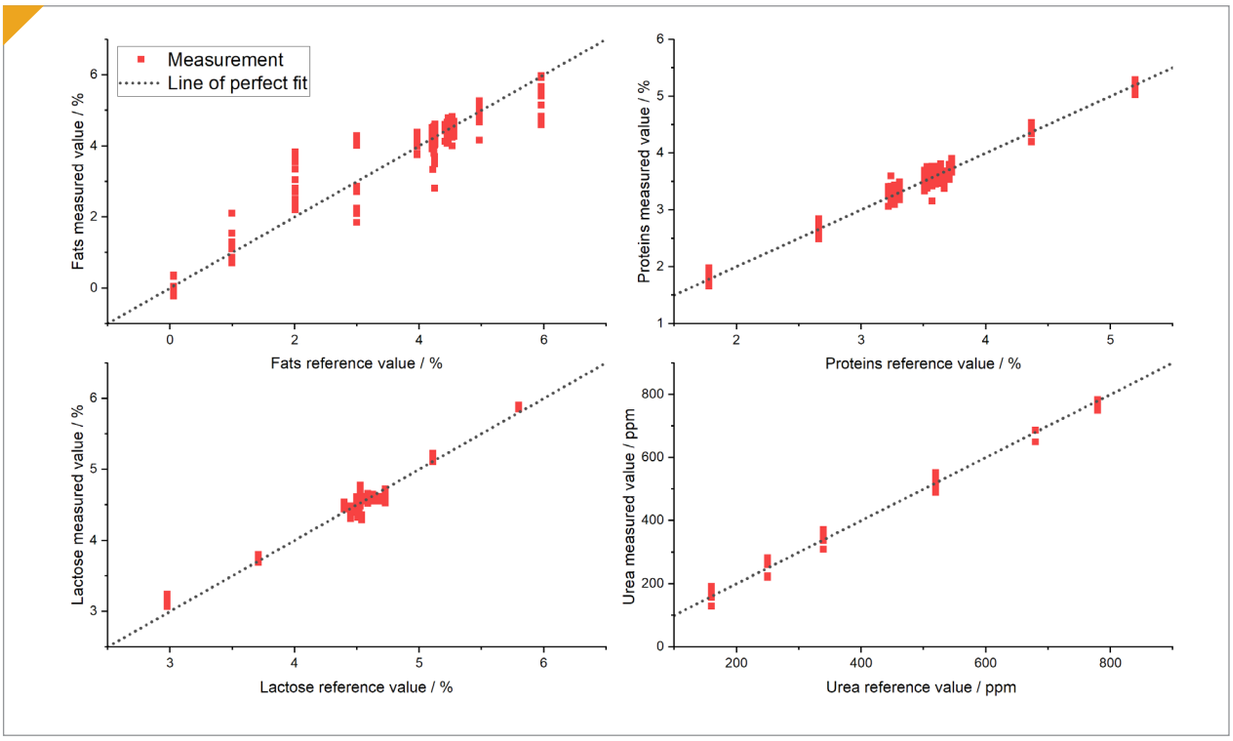

Figure 2: Calibration curves for fats, proteins, lactose and urea in milk samples.

How well does it work?

Quantitative calibrations – i.e. concentration measurements

The limit of detection depends on the exact chemical makeup of the process you want to measure, and where in the production line the IRmadillo is installed. Typical measurement performance is:

- Fats: ± 0.85 %
- Proteins: ± 0.2 %
- Lactose: ± 0.10%
- Urea: ± 90 ppm

Qualitative calibrations – i.e. process classification

Again, this depends on the process you wish to measure, and the exact different process states that need classification. Classification models can run simultaneously to measurement models, and can identify issues such as:

- Contamination spotted
- Quality determination (low, medium and high)
- Unusual process detection – perform further analysis

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Features & Benefits

- FTIR (mid-infrared) spectroscopy
- Vibration tolerant
- On-line & In-line process monitoring
- Long-term stability
- Low maintenance
- Compact design
- Real-time, multi-component analysis
- Ease of use