# Potentiality of an automatic Near-infrared system with fiber optic probe for daily on-line monitoring at the milking parlour

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## 1. Aim

**Potentiality of a Fourier transforms Near-infrared (FT-NIR) device to automatically record multiple spectra of individual raw milk samples taken directly in the process of milking.**

## 2. Materials and methods

**Automatic on-line NIR device**

- Hardware, automation and measure sequence were performed using a FT-NIR Matrix-F (834 - 2502 nm) spectrometer from Bruker Optics (Ettlingen, Germany).
- Connexion of a transflection fiber optic probe (IN271P, Bruker Optics) for the measurement.
- Transfer of level signal via a logic and data acquisition module.
- Integration of the probe in the flowmeter (milk container) at one post of the milking parlour within the CRA-W farm.

**A NIR recording of the milking**

- Automatic data acquisition was performed during 12 weeks on the CRA-W herd.
- All individual recordings consisted of 4 periods (1-4) of the milking, both morning (M) and evening (E).
- For the statistical stage, selection of 34 complete recordings (9 cows with at least twice parity M/E) from a first trial of 352 exploitable recordings.

## 3. Results and discussion

- Prediction of the measured spectra : Partial Least Squares regression (PLS) models for Fat ($R^2_{CV}$ : coefficient of determination for cross-validation = 99.5%; RPD : ratio of performance to deviation = 13.6) and Protein ($R^2_{CV}$ = 96.9%; RPD = 5.7).
- Calculation of Range (Min-Max), Mean and Standard deviation (SD) to have a relevant evaluation of the data distribution.
- Our first observations showed that Fat content (general trend) varies widely during the milking. Protein general trend showed lower changes.
- Figures 1 and 2 : one complete recording (cow no. 844) to illustrate the variations of Fat and Protein content during milking.
- Table 1 : Summary of different statistical parameters derived from the set of 34 recordings.

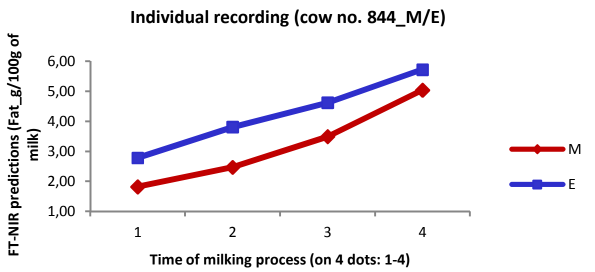


**Figure 1.** Example of the variation of Fat content (g/100 g of milk) measured during the morning (M) and the evening (E) automatic recording for cow no. 844.

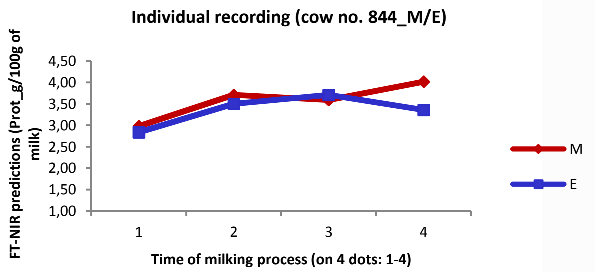


**Figure 2.** Example of the variation of Protein content (g/100 g of milk) measured during the morning (M) and the evening (E) automatic recording for cow no. 844.

| Fat (M) | 1 | 2 | 3 | 4 | Fat (E) | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|---|
| Min-Max | 0.99 - 3.18 | 1.08 - 4.79 | 2.43 - 5.01 | 3.22 - 6.16 | Min-Max | 0.76 - 4.28 | 1.59 - 4.45 | 2.43 - 5.46 | 1.56 - 5.88 |
| Mean | 1.79 | 2.55 | 3.31 | 4.50 | Mean | 1.99 | 2.89 | 3.62 | 4.62 |
| Protein (M) | 1 | 2 | 3 | 4 | Protein (E) | 1 | 2 | 3 | 4 |
| Min-Max | 1.99 - 3.88 | 2.70 - 4.19 | 3.06 - 4.07 | 2.70 - 4.26 | Min-Max | 2.28 - 3.48 | 2.79 - 4.19 | 2.35 - 4.20 | 2.69 - 4.91 |
| Mean | 3.09 | 3.56 | 3.54 | 3.74 | Mean | 3.04 | 3.26 | 3.59 | 3.70 |
| | Fat (M) | Fat (E) | Protein (M) | Protein (E) | | Fat (M) | Fat (E) | Protein (M) | Protein (E) |
| SD range of 1-4 | 0.18 - 1.81 | 0.39 - 1.68 | 0.14 - 0.63 | 0.13 - 0.83 | SD of Mean (1-4) | 1.00 | 0.97 | 0.24 | 0.26 |

**Table 1.** Statistical characteristics of data distribution for the estimation of Fat and Protein content (g/100 g of milk) of the 34 complete recordings.

## 4. Conclusion

**Interest to split the process in several periods in order to draw a kinetic curve : detection of any irregular individual milk production by comparing the tendency over time. With such a system, any variation in milk production could be more quickly perceived than models currently based on the average composition of milk.**

*This study was carried out as part of the Milkinir research project supported by the Agricultural Head Office of the Walloon region - DGARNE-DGO 3 (Belgium)*

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