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

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# Introduction

- Dairy activity : strategic sector
- Continuous structural modifications
- Infrared techniques (Mid and Near)
- Interactive decision tools

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# Aim

- Management and control system
- Direct application during milking
- Automatic on-line recording device : Near-infrared spectroscopy (**NIRS**)
- Multi-parameter
- Profitability of the dairy activity: Health, Nutrition, Fertility, Quality and Sustainability

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# Materials and methods

*Milk sampling for infrared recording*

- Targeted sampling
- Infrared analysis (mid and near) and reference values (wet chemical methods)
- Database : > 12 000 raw milk samples

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*NIR automatic on-line recording device at the milking parlour*

- FT-NIR MATRIX-F spectrometer (Bruker Optics, Ettlingen, Germany) active in the 1000-2500 nm range

- Coupled to a fibre optic probe adapted for transflection measurement of milk (IN271P-02, Bruker Optics transflection probe for process control)

- Installed at the CRA-W (Walloon Agricultural Research Centre) milking parlour facility

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➢ Technical partners : Wetlands engineering SPRL (Louvain-la-Neuve, Belgium) and Bruker Optics (Ettlingen, Germany)

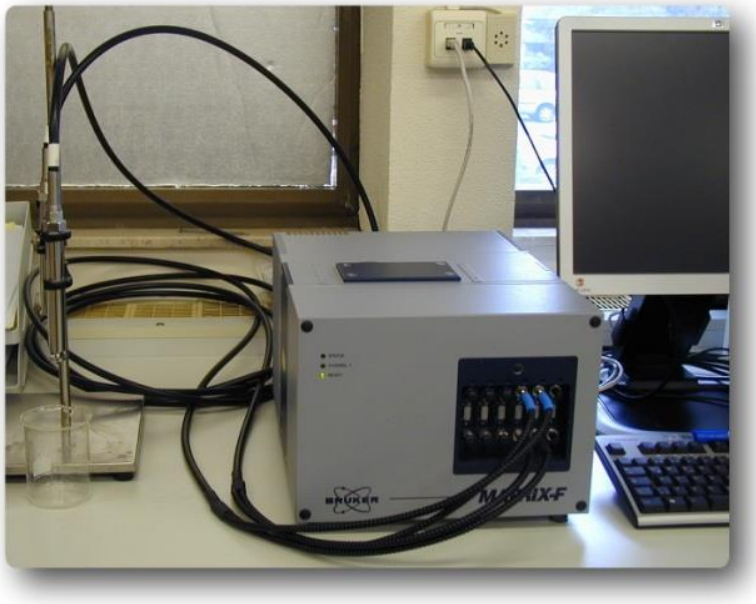


**Figure 1** : FT-NIR Matrix-F spectrometer, equipped with transflection fiber optic probe.

**Figure 2** : NIR automatic on-line recording device installed at the CRA-W milking parlour.

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# Results

- Calibration step of NIR instruments
- Ratio of performance to deviation (RPD) > **2.4**
- To exploit the infrared information collected in the milking room
- **Table 1** : Summary of the statistical results obtained on raw milk for FT-NIR Matrix-F instrument, equipped with a fiber optic probe (IN271P, Bruker Optics)

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**Table 1 :** Summary of the statistical results obtained on raw milk for FT-NIR Matrix-F instrument, equipped with a fiber optic probe (IN271P, Bruker Optics).

| Component | $R^2_{CV}$ * [%] | $SE_{CV}$ * | RPD * | Range | Units |
|---|---|---|---|---|---|
| **Fat** | 99.5 | 0.07 | 13.6 | 1.85 - 7.55 | **g/100g** |
| **Protein** | 96.9 | 0.07 | 5.7 | 2.46 - 4.38 | **g/100g** |
| **Casein** | 98.8 | 0.06 | 9 | 1.91 - 4.02 | **g/100g** |
| **Lactose** | 71.5 | 0.09 | 1.9 | 3.95 - 5.28 | **g/100g** |
| **Dry matter** | 97.4 | 0.15 | 6.3 | 10.77 - 16.74 | **g/100g** |
| **Urea** | 23.2 | 9 | 1.1 | 1 - 50 | **mg/100g** |
| **FA profile** | | | | | **g/dl** |
| **SFA** | 93.6 | 0.18 | 4 | 1.09 - 4.81 | |
| **MUFA** | 92.5 | 0.17 | 3.7 | 0.60 - 3.05 | |
| **PUFA** | 66.0 | 0.02 | 1.7 | 0.06 - 0.21 | |
| **UNSAT** | 97.9 | 0.09 | 6.9 | 0.69 - 3.23 | |
| **SCFA** | 90.0 | 0.03 | 3.2 | 0.12 - 0.65 | |
| **MCFA** | 94.8 | 0.13 | 4.4 | 0.85 - 3.62 | |
| **LCFA** | 96.9 | 0.14 | 5.7 | 0.84 - 3.85 | |
| **Minerals** | | | | | **mg/kg** |
| **Calcium** | 61.3 | 108 | 1.6 | 908 - 1578 | |
| **Phosphore** | 69.9 | 117 | 1.7 | 831 - 1696 | |

**Abbreviations - $R^2_{CV}$** : coefficient of determination for cross-validation; **$SE_{CV}$** : standard error of cross-validation; **RPD** : ratio of performance to deviation; **SFA** : saturated fatty acids; **MUFA** : monounsaturated fatty acids; **PUFA** : polyunsaturated fatty acids; **UNSAT** : unsaturated fatty acids; **SCFA** : short-chain FA; **MCFA** : mid-chain FA; **LCFA** : long-chain FA.

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- Installation of the automated NIR device, directly connected to a milking parlour of the CRA-W experimental farm

- Recording sequence (initiation, reading duration, waiting interval, etc.)

- NIR device : now operational for routine process

- Adjustment : to collect over the duration of the milking up to 4 periods (spectra) by animal

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➢ In parallel : creation of an experimental computer program

➢ To gather diverse parameters : NIR spectra and information from the herd (individual production, health status, etc.)

➢ Coming soon : metabolic trials on the herd of CRA-W farm

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# Conclusion

- Real potentiality of NIRS
- Integration of automated on-line measurement during the milk process
- During the trials on herd : creation of decision tools based on the whole results of the MILKINIR project

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# Thanks for your attention !

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