



*Genotype **plus** Environment*
Integration for a more sustainable dairy production system

Mid-infrared milk analysis based technologies adding value to gene banks

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*Genotype **plus** Environment*
Integration for a more sustainable dairy production system

***Genotype and Environment** contributing to the sustainability of dairy cow production systems through the optimal integration of genomic selection and novel management protocols based on the development and exploitation of genomic data and supporting novel phenotyping approaches*

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- 15 partners

- University College Dublin (Co-ordinator)
- Royal Veterinary College
- AFBI
- University of Ghent
- Aarhus University
- CREA
- ICBF
- Huazhong University
- Service EAAP
- Unifarm BVBA
- SEGES
- University of Missouri
- University of Liege
- Walloon Centre for Agricultural Research
- Leibniz Institute for Farm Animal Biology
- 6 EU member states (Belgium, Denmark, Germany, Italy, Ireland and the UK), USA (Missouri) and China (Huazhong)





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novel phenotyping approaches → mid-Infrared spectra

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Context

- First sight → quiet unusual to associate mid-infrared spectral data to gene banks
- However the magic word : **characterization!**
- Genomic characterization → straight forward
- Phenotypic characterization → interest less obvious
- Some traits may be so novel not yet known (as being of interest) when material was conserved!



Take-Home Message of Today

Mid-infrared spectra based milk analysis strategies as studied during EU FP7 project  allow to add value to gene bank collections



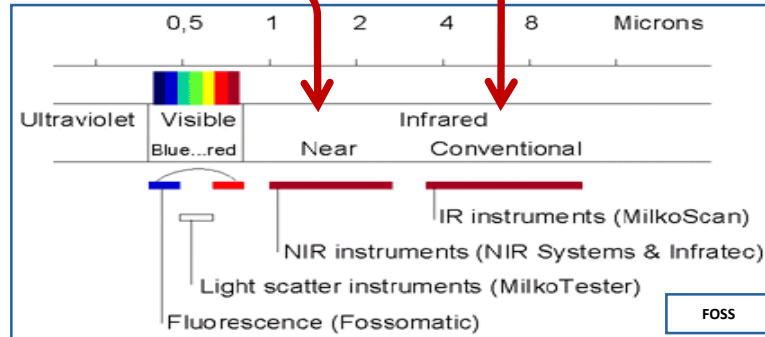
What is Infrared (IR) Spectroscopy?

- IR spectroscopy or Vibrational spectroscopy
 - Interaction of infrared radiation with matter
- Large range of techniques, e.g.
 - Absorption spectroscopy (more liquids, gases)
 - Reflectance spectroscopy (more solids)
- Instruments called IR spectro(photo)meters
- Methods often called “Spectrometry”
 - As it is about quantification



IR Spectral Ranges

- Types of IR spectra ranges (here in milk applications)
 - Mid-Infrared (MIR)
 - Near-Infrared (NIR)



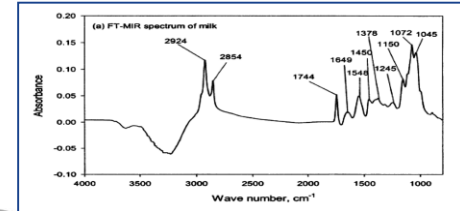
How Do MIR Based Predictions Work ?



Milk samples
(milk payment, milk recording)



MIR spectrometry analysis



Raw data = MIR spectra

Quantification:

Existing: fat, protein, urea,....

Calibration equations

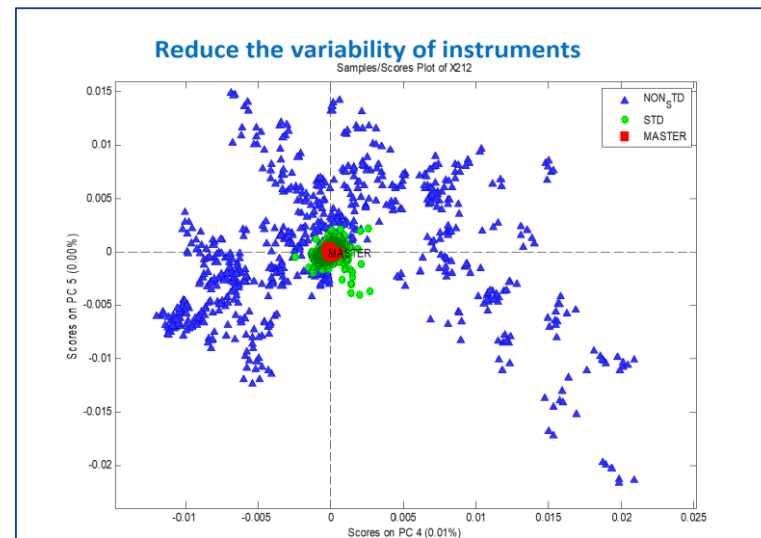
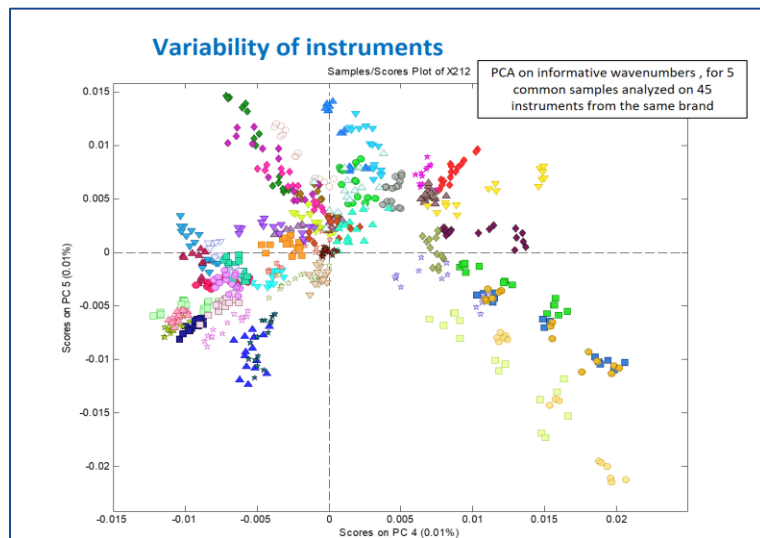


Required

- Recording of spectra for individuals of to be preserved
- Better from “standardized” spectrometers (see following slide)
- Preservation for at least a part of these MIR records
➔ corresponding preserved (frozen) milk



Standardization of MIR Spectra....



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Standardization of milk mid-infrared spectra from a European dairy network

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J. Dairy Sci. 100:7910–7921
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Standardization of milk mid-infrared spectrometers for the transfer and use of multiple models

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How Can MIR Add Value?

At least four ways MIR based technologies can help

1. Novel MIR prediction equations developed after initial conservation of MIR data

➔ used to determine a posteriori novel phenotypes for preserved animals ➔ select animals of interest



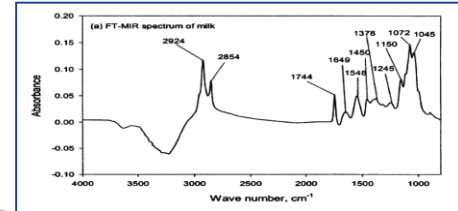
New MIR Predicted Phenotypes



Milk samples
(milk payment, milk recording)



MIR spectrometry analysis



Raw data = MIR spectra

Quantification:

New: fatty acids, CH₄,

New calibration equations



How Can MIR Add Value?

2. Preserved frozen samples associated to MIR records obtained before

- ➔ used to validate, or even improve equations adding variability that has, maybe, disappeared since preservation (NB: freezing is not a good idea for MIR, but many reference methods can be used on previously frozen samples)



How Can MIR Add Value?

3. Frozen samples useful because novel reference methods (e.g., proteomics) may appear

➔ used increase variability of reference calibration datasets



How Can MIR Add Value?

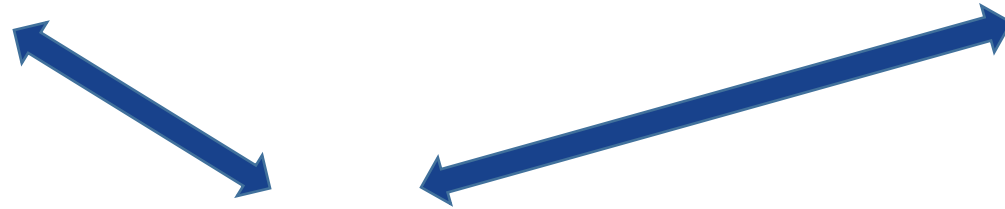
4. Global MIR spectra \leftrightarrow milk phenome \rightarrow genome

→ used to establish breed difference
(deeper than MIR predictions based)



Also

Using genome ↔ Using MIR based milk phenome



Selection of candidates for gene banks



Conclusions

Mid-infrared based technologies → adding value to gene banks

Conditions:

- Large scale MIR spectra taking organized
- (Standardized) MIR spectra of animals or close relatives preserved
- Associated frozen reference samples are kept

Many opportunities → increased possibilities for
extensive characterization and utilization



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