Full spectral approach fostering the development of new innovative concepts

Gavin Scott, Silvia Orlandini & Frédéric Dehareng

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Introduction

Fig. 1 Photograph of infra red milk analyzer fitted with digital voltmeter output

1961 Dr Goulden Developed the first MIR instrument called IRMA. Patented in 1961.
MIR Filter apparatus

Infrared Source → Monochromator → Milk sample

Reference → Detector → Data output

Homogenizer
Principle

MIR Filter apparatus

Lactose

Protein

Fat A

Fat B
Principle

FT-MIR apparatus

Source

Polychromatic Radiation

Interferometer (Michelson)

Stationary mirror

Moving mirror

Sample

Detector

COMPUTER

MIR Spectra

[Diagram of FT-MIR apparatus with labels for source, interferometer, stationary mirror, moving mirror, sample, detector, and MIR spectra]
Interest of a full spectral approach?

1. New parameters
2. Creation of common or global models
3. Spectral standardization
4. Creation of spectral database
5. Future?
1. New parameters: some examples

- **Fat, Protein, Lactose, SNF**
- **Fatty acids** Soyeurt et al. 2006 J. Dairy Sci. 89: 3690–3695
- **Lactoferrin** Soyeurt et al. 2007 J. Dairy Sci. 90: 4443–4450
- **Major minerals** Soyeurt et al. 2009 J. Dairy Sci. 92: 2444–2454
- **Coagulation, titrable acidity, pH** De Marchi et al. 2009 J. Dairy Sci. 92: 423-432
- **Blood BHB and NEFA** M. Gelé et al. 2015, ICAR
- **Body Energy status** Mc Parland et al. 2011 J. Dairy Sci. 94: 3651–3661
- **Methane** Dehareng et al. 2012 Animal. 6 : 1694-1701
1. New parameters

Need the full range covered to ensure Robust calibrations
2. Creation of common / global models

• To cover the all variability (feeding system, breeds, seasons, etc.)
  
  Increase the robustness of the equation

• To decrease the cost of reference analysis

• To use on different apparatus from the same manufacturer

  from different manufacturers

Common procedure for spectral Standardization
2. Creation of common / global models

Example: common model for predictions of individual methane emissions (g/d)

<table>
<thead>
<tr>
<th>Constituent</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>$R^2_c$</th>
<th>$R^2_{cv}$</th>
<th>SEC</th>
<th>SECV</th>
</tr>
</thead>
<tbody>
<tr>
<td>CH$_4$</td>
<td>863</td>
<td>459</td>
<td>123</td>
<td>0.71</td>
<td>0.67</td>
<td>66</td>
<td>71</td>
</tr>
</tbody>
</table>
3. Spectral Standardization

- 83 instruments
3. Spectral Standardization

Spectral standardization

→ 83 instruments
3. Spectral Standardization

Impact of standardisation

- Harmonize the spectral format
- Allow merging of data
- Creation of common models

Models can be used on all instruments
4. Creation of spectral database
4. Creation of spectral database

New equation

e.g. Methane equation
5. Future?

A lot of new opportunities

Examples

• New management tools
5. Future?

Example of management tool developed by AWE (BE)

- Walloon breeding association (AWE) tool using models developed in Optimir project
- Global Ketosis index tool: Combination of BHB, acetone predictions and fat/protein ratio
- Relative approach for each biomarker: Cow value compared to population values at same DIM
5. Future?

Example of management tool developed by AWE (BE)

- Global score from 0 to 6 as a global indication for ketosis status
- Currently in test in 75 farms
- Good feedback from cattle breeders
5. Future?

Example of management tool developed by CLASEL (FR)
5. Future?

A lot of new opportunities

Examples

• New management tools
• New tools for genetic evaluation/genomic
• New tools for milk adulteration
• But...!
  • International collaboration needed
  • Spectral Standardization
Thank you

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