Innovative analytical and automation solutions to extract the maximum value of every milk samples for optimal herds management

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Introduction

EU milk production is shifting to a more sustainable model associated with the reduction of milk production over the coming years.

This shift will probably keep increasing market segmentation with consumers demand for high-quality, healthy and sustainable dairy products, especially for organic, low-fat, low-sugar, no allergens, probiotic and fortified dairy products. Cheese and whey are expected to benefit the most from this shift.

Sustainability is increasingly important to the dairy industry. Producers will need to adapt to reduce their carbon footprint and environmental impact, while maintaining their business profitability.

How to produce high quality dairy products while taking into account all new societal and environmental demands in terms of health, sustainability, animal welfare, carbon footprint, at a price accepted by consumers? What are the new milk components and functionalities of interest? Can milk composition and functionalities be optimized to meet markets new demand?

Reference methods are typically time consuming and quite expensive. New fast alternative, standardized and cost effective analytical methods are necessary to promote and monitor these new compositional and functional evolutions throughout the dairy chain.

FT-MIR technology is one of the obvious candidate being already used since 1990 on a large scale in the dairy industry and central milk testing laboratories for milk payment, dairy herd management and incoming milk and process monitoring.
Innovative Analytical & Automation Solutions for the Dairy Industry

Bentley Instruments, Inc (USA)

- Company established in 1983 (near Minneapolis)
- Presents in > 60 countries
- > 110 employees
- 5 Subsidiaries in Europe + distribution network
- All our instruments IDF/ISO/ICAR certified
- Market: dairy industry exclusively
Solutions for the Dairy Plants for the rapid and highly accurate determination of milk chemical and hygienic composition

DairySpec FT
Milk/Dairy Products
Up to 64 chemical components
ICAR certified

SomaCount FC
Somatic Cells
ICAR certified

New BactoCount IBCM3
Total bacteria/Somatic cells
ISO 16140 certified
By far, the fastest method on the market for total bacteria testing
Solutions for the Central Milk Testing Laboratories

**BactoCount:** Rapid and highly accurate determination of milk hygienic composition

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**New BactoCount IBC 200 Multiplex**

Total Bacteria/Somatic Cells

Up to 200 samples/hour

ISO 16140 Microval Certified

Cow/Sheep/Goat

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**BactoCount IBC 50-150**

Total Bacteria

ISO 16140 Microval Certified
Solutions for the Central Milk Testing Laboratories
Only Combi systems ICAR certified for cow, goat and sheep milk testing

CombiFTS 400/500/600
FTIR+FC (up to 64 components)

IR spectra standardized in real time
without any reagent

DairySpec Combi 100/200/300
FTIR+FC (up to 64 components)
Bentley Combi FTS 600 & Ilas 3000 robot
Fully automated and standardized samples preparation for the highly accurate determination of milk chemical and somatic cells composition

Main characteristics:
- Up to 600 samples/hour (Combi FTS)
- Up to 64 chemical parameters analyzed simultaneously
- Spectra standardized* in real time (without reagents)
- Samples handling fully automated and standardized for optimal analytical performances

The samples are automatically:
- Identified (RFID, code-barres...)
- Heated to 40°C or Cooled at 4°C
- Inverted and uncapped
- Analyzed
- Replaced in their original position
*patented
Milk contains more than 400 individual fatty acids:
(over 100 publications over last decade)

De Novo/Short Chain Fatty Acids (18-30%) 
C4:0, C6:0, C8:0, C10:0, C12:0, C14:0, C14:1

Preformed/Long Chain Fatty Acids (30-45%) 
C18:0, C18:1, C18:2

Mixed/Medium Chain Fatty Acids 
C16:0, C16:1

Traditional Fatty Acids 
Saturated, Unsaturated, Mono & Polyunsaturated, Oleic (C18:1), Palmitic (C16:0) and Stearic (C18:0)
New biomarkers for ketosis detection
Blood BHB*(from milk spectrum)
Milk Amyloid A (MAA): a potent biomarker for early mastitis diagnosis and milk quality monitoring

<table>
<thead>
<tr>
<th>Natural Clinical Mastitis</th>
<th>Natural Subclinical Mastitis</th>
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<tbody>
<tr>
<td><strong>Sensitivity</strong></td>
<td><strong>Sensitivity</strong></td>
</tr>
<tr>
<td>93.0%</td>
<td>90.6%</td>
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<tr>
<td><strong>Specificity</strong></td>
<td><strong>Specificity</strong></td>
</tr>
<tr>
<td>100%</td>
<td>98.3%</td>
</tr>
<tr>
<td><strong>Reference</strong></td>
<td><strong>Reference</strong></td>
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<tr>
<td></td>
<td>Shirazi-Beheshtiha et al. 2012</td>
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MAA is the only Acute Phase Protein produced directly by the epithelium of the udder in response to bacterial infection in the udder and as such is an immediate and direct marker of infection.
Bentley Combi FTS

New potential developments: Milk-based Genetic analysis & selection

Sequence-based genome-wide association study of milk mid-infrared wavenumbers in dairy cattle

Kathryn Tiplady

T. Lopedell¹, E. Reynolds¹, R. Sherlock¹, M. Keehan¹, T. Johnson¹, J. Pycke¹, H. Blais¹, S. Davis¹, M. Littlejohn¹,², D. Garrick¹, R. Spielman¹ and B. Harris¹

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³Agriculture Victoria, AgriBio, VIC, Australia
⁴La Trobe University, VIC, Australia

Bonferroni-threshold: 0.01/17.7m/895=6.3 x 10⁻¹³. Significant associations conserved across multiple wavenumbers: DGAT1 significant for over 750 wavenumbers.²
Development of new IR milk phenotypes necessary to keep improving dairy herds management and sustainability

- **Feeding optimization**: fatty acids profile, urea, protein...
- **Early mastitis detection**: SCC, Milk Amyloid A, lactoferrin, citrate ...
- **Early Ketosis detection**: Blood BHB*, ketone bodies, citrate, fatty acids profile ...
- **Breeding/Genetic selection**: Standardized IR spectra*, fat & protein profiling, urea, ketone bodies...
- **Environmental impact mitigation**: nitrogen, methane emission (from fatty acids profile), phosphorus....

*patented
A new holistic approach for the optimum valorization of every milk samples

Why?

- **Streamline mass & multiplex testing at the sample level** to reduce operation costs while extracting the maximum value of every samples of interest by intelligently combining multiple analytical methods

- **Standardize milk samples preparation** and handling before testing, a critical step to secure analytical methods standardization and performances for worldwide results equivalence

- **Increase laboratory throughput** with potential speed up to 600 samples/hour and deal more efficiently with peaks in samples distribution with samples automatically dispatched to open analyzers
Innovative analytical and automation solutions to extract the maximum value of every milk samples for optimal herds management
Conclusion

The development of a holistic model combining latest high throughput standardized methods in combination with complete laboratory automation makes it possible to streamline mass & multiplex testing at the sample level for the benefit of the dairy industry.
Thank you for your attention!
Looking forward to meeting you on our stand
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