

**Project number:** 6160  
**Funding source:** INTERREG

**Date:** Sept 2015  
**Project dates:** Sept 2010 – Sept 2015

## OptiMIR: new tools for a more sustainable dairy sector



### Key external stakeholders:

The Irish Cattle Breeding Federation (ICBF)  
Dairy and beef farmers  
Milk processors  
Irish Dairy Board & Bord Bia  
Scientists

### Practical implications for stakeholders:

This study

- Put in place the necessary mathematical approaches and logistics for the harmonisation of infra-red spectroscopy data across European spectrometers used in the quantification of milk quality
- Developed a trans-national database for infra-red spectra & phenotypes
- Ensures that spectral data are now collected and stored from several Irish milk testing spectrometers
- Improved that prediction accuracy of milk fatty acids from infrared spectroscopy of milk through the addition of new data from European partners
- Developed prediction equations for acidosis, ketosis, milk mineral content and cow methane emission from infrared spectroscopy analysis of milk

### Main results:

- Several milk components and animal-level characteristics can be predicted with moderate to high accuracy from milk mid-infrared spectra (MIR)
- Milk MIR does not greatly add to the prediction of future likelihood of conception or likelihood of mastitis, on average, but has good sensitivity when only high predicted probabilities are considered

### Opportunity / Benefit:

Accurate phenotyping for a range of traits using milk MIR which is already generated on >0.5 million Irish cows several times annually and can therefore be implemented at negligible cost

### Collaborating Institutions:

Association Wallonne de l'Elevage asbl (AWE asbl) [www.awenet.be](http://www.awenet.be)  
Chambre régionale Agriculture Alsace  
CLASEL (Sarthe et Mayenne)  
Organisme de Contrôle Laitier du Doubs et du Territoire de Belfort (OCL25)  
France Conseil Elevage (FCEL)  
Institut de l'Elevage  
Gembloux Agro BioTech, Université de Liège (GxABT-ULg) [www.gxabt.be](http://www.gxabt.be)  
Landesverband Baden-Württemberg für Leistungsprüfungen in der Tierzucht e. v. (LKV-BW)  
Institut für Tierernährung, Universität Hohenheim  
Landeskontrollverband Nordrhein-Westfalen e. V. (LKV-NRW)  
Centre wallon de Recherches agronomique, département  
Comité du Lait asbl  
Scottish Agricultural College (SAC)  
National Milk Recording (NMR)  
CONVIS Herdbuch Service Elevage et Génétique

<b>Teagasc project team:</b>	Donagh Berry (PI) Sinead McParland,
<b>External collaborators:</b>	Association Wallonne de l'Elevage asbl (AWE asbl) - Carlo Bertozzi, Chambre régionale Agriculture Alsace - Philippe Caussanel, Association départementale de Contrôle Laitier du Pas de Calais - Christian L'Homme, CLASEL - Jean-Bernard Daviere, Organisme de Contrôle Laitier du Doubs et du Territoire de Belfort - Daniel Pourchet, France Conseil Elevage - Christophe Lecomte, Institut de l'Elevage - Philippe Brunschwig, Gembloux Agro BioTech, Université de Liège - Nicolas Gengler, Landesverband Baden-Württemberg für Leistungsprüfungen in der Tierzucht - Fritz Golle-Leidreiter, Institut für Tierernährung, Universität Hohenheim - Herbert Steingaß, Landeskontrollverband Nordrhein-Westfalen - Rudolf Schmidt, Centre wallon de Recherches agronomique, département Valorisation des Productions agricoles - Frédéric Dehareng, Comité du Lait asbl - Emile Piraux, ICBF - Sean Coughlan, SRUC - Mike Coffey, National Milk Recording - Andy Warne, CONVIS Herdbuch Service Elevage et Génétique - Armand Braun

### 1. Project background:

North-west Europe produces 60% of the EU milk which represents 13% of the turnover of the food industry in EU-27. This project aims to improve the sustainability of the dairy sector by providing milk producers with tools enabling them to manage the cows' fertility, feeding, health, pollutants, milk quality, etc. Milk records will be used in an innovative way: the entire MIR milk spectrum, including variations in its shape will be used as indicators of the cows' status for a range of characteristics:

1. To reduce the costs of production through improved daily herd management
2. To access higher value-add markets for dairy products
3. To ameliorate the impact on the environment through quantification of methane and nitrogen production using milk MIR.

Milk Recording Organizations (MROs) globally collect milk samples on individual cows several times per lactation. Each sample is subjected to MIR analysis. Thus generating additional information from the MIR implies that such research can be immediately implemented and at negligible cost. The MIR spectra generated from a standard sample however varies per spectrometer and even within spectrometer over time. Thus harmonisation of the generated spectral must be optimally understood so the developed prediction equations can be applied.

### 2. Questions addressed by the project:

This project is predominantly an extension project with minimal research. The research component of this project however will attempt to address:

- The optimal approach to standardise the generated spectra across different spectrometers.
- The development of a transnational database of relevant phenotypes and MIR data
- The usefulness of the milk spectrum including variations in its shape to predict milk and cow level characteristics

### 3. The experimental studies:

- All partners participated in a regular ring-test of their respective spectrometers using a standard milk sample
- Animal level phenotypes collected as part of on-going projects were collated
  - Phenotype categories of particular interest were:
    - Fertility
    - Health
    - Energy balance
    - Methane emissions
- Collection, transfer and storage of MIR from several Irish spectrometers was initiated

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#### 4. Main results:

- It is possible to standardise spectral from a range of different spectrometers (even different manufactures); the optimal approach is through a master and slave approach where the spectral of the slave machines is altered to be in line with that of a single master spectrometer
- The ability to predict whether or not a cow is in calf is high using cross-validation but does not achieve high accuracy of prediction when applied to an independent dataset
- Accuracy of prediction of likelihood of conception to a given service was, on average, low and MIR information added little marginal value over and above other animal-level characteristics; however, prediction accuracy was reasonable when on only focusing on individuals with a high predicted probability of conception
- Prediction of the likelihood of succumbing to mastitis in the near future using MIR was poor
- Energy balance can be moderately accurately predicted from milk MIR substantiating previous research at Moorepark
- Methane emissions can be reasonably predicted using milk MIR

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#### 5. Opportunity/Benefit:

- MIR spectral is now being routinely collected and stored from a large proportion of Irish cows which can subsequently be used to estimate a range of milk-level and animal-level characteristics

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#### 6. Dissemination:

##### Main publications:

Carthy, T.R., Berry, D.P., Fitzgerald, A., McParland, S., Williams, E. J., Butler, S., Cromie, A.R. and Ryan, D. (2014). Risk factors associated with detailed reproductive phenotypes in dairy and beef cows. *Animal* 8:5, pp 695-703

Carthy T.R., D.P. Ryan, A.M. Fitzgerald, R.D. Evans, D.P. Berry. 2015. Genetic parameters of ovarian and uterine reproductive traits in dairy cows *Journal of Dairy Science*, In Press

Hempstalk, K., S. McParland, & D.P. Berry (2015). Machine learning algorithms for the prediction of conception success to a given insemination in lactating dairy cows. *Journal of Dairy Science* (in Press).

##### International conferences

Presented at many international conferences, invited and contributed, such as the European Association of Animal Production, INTERBULL, ICAR, American Dairy Science Association Annual meeting, and the World Congress on Genetic Applied to Livestock Production (<http://www.optimir.eu/en/publications.php>).

##### National Conferences and seminars

Presented at the Agricultural Research Forums through the duration of the project

##### Open Day

Presented at all Moorepark open days.

##### Industry consultation days

Presented and discussed at several industry meeting days with representatives from the different AI organisations, breed societies, Teagasc extension service, farmer groups and farmers.

##### Farmer discussion groups

Discussed at many farmer discussion groups and seminars.

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#### 7. Compiled by: Dr. Donagh Berry

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