G PLUS E

Genotype *plus* Environment
Integration for a sustainable animal production system

New genomic and management tools for healthier dairy cows

**Prof.
Mark Crowe**
*GplusE
Coordinator*

The results obtained in GplusE will help dairy producers moving to more sustainable practices.

Our results show that one can detect cows with imbalanced energy status thanks to the measurement of a few biomarkers in milk.

These will enable animal breeders to improve the selection of resilient, yet highly productive animals.

They will also help farmers, veterinarians and MROs to manage dairy herds better, via individual monitoring of the health and welfare of the animals.

Key results

An innovative research population obtained from research herds based in 5 countries provided the phenotypic variability to develop novel approaches linking milk composition based biomarkers to production efficiency, health, metabolic status, fertility, environmental footprint and animal welfare state; some key results were:

• Milk MIR spectra can be used for a cheap, easy to implement and accurate prediction of the metabolic status of dairy cows: models have been constructed that can evaluate whether a cow is metabolically imbalanced with a global accuracy of 87 %.

Grelet et al., 2018, https://doi.org/10.1017/S1751731118001751
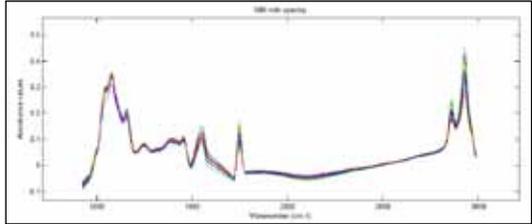
• Milk MIR spectra might also be used for predicting many other innovative phenotypes (e.g., GplusE added knowledge on the prediction of Nitrogen efficiency of dairy cows).
Clément Grelet <c.grelet@cra.wallonie.be>

• The combined measurements of BHB (Beta-Hydroxy-Butyrate), NEFA (Non esterified Fatty Acids) and IGF-I allows determination of whether the energy metabolism of an animal is imbalanced.
Measurements in milk can predict metabolic status with a fair accuracy. MIR spectra and measurements of metabolites & enzymes work fine, IgG glycans had insufficient accuracy.
Miel Hostens <Miel.Hostens@ugent.be>

The results from the research population were used to obtain the many novel results in a larger population of MIR phenotypes and genotyped commercial cows; a few highlights:

• Targeted combination of estimated breeding values for lower accuracy MIR based biomarkers increased their usefulness in genetic evaluation of dairy cattle for robustness.
Nicolas Gengler <nicolas.gengler@uliege.be>

• Genome wide association studies may help in selection for improved resilience of dairy cattle to heat stress.
Hedi Hammami <hedi.hammami@uliege.be>

The project also studied relationships between some molecular phenotypes for key physiological traits:

• RNA sequencing data were obtained from whole blood and liver of genotyped cows with extensive phenotype data available. These have identified gene pathways linking metabolic status with fertility and mastitis, providing new evidence to understand the relationships between immune status and health in postpartum dairy cows.
Claire Wathes <dcwathes@RVC.AC.UK>

GplusE-developed biomarkers worked not only in breeding; using the same innovative phenotypes, they contributed to advances in management:

• An HACCP approach for farm level management of critical negative energy balance has been developed: 11 risk factors and 7 critical control points have been identified as the most important ones. Benefits from using milk MIR prediction of physiologically imbalanced cows in the approach have been evaluated by on-farm trials and by economic analyses.
Søren Østergaard <soren.ostergaard@anis.au.dk>

Visit our webpage
http://www.gpluse.eu/

• To get an updated list of our publications;
• To be informed on the venue and date of the final meeting of GplusE;
• To see the videos of the trainings schools organised by GplusE:
 "New genomic and management tools for healthier dairy cows";
• To see the video showcasing the impact of GplusE on our daily lives;
• To get a list of contacts for key people in the project.

Project Partners

The GplusE consortium involves academic and industry partners from six EU countries together with the USA and China to allow access to a range of Holstein sub-types kept under both pasture-based and indoor intensive dairy systems

UCD: University College Dublin, School of Veterinary Medicine
Dublin, Ireland

RVC: Royal Veterinary College
London, UK

AFBI: The Agri-Food and Biosciences Institute
Belfast, Northern Ireland, UK

UGent: Universiteit Gent, Faculty of Veterinary Medicine
Merebelke, Belgium

AU: Aarhus University, Department of Animal Science
Foulum, Denmark

CREA: Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria, *Roma, Italy*

ICBF: The Irish Cattle Breeding Federation Society Limited
Bandon, Ireland

HZAU: Huazhong Agricultural University
Wuhan, China

sEAAP: Service EAAP Srl, *Roma, Italy*

UNIFARM: Unifarm BVA, *Assen, Netherlands*

KCA: The Knowledge Centre for Agriculture
Aarhus, Denmark

MU: University of Missouri
Columbia, MO USA

ULiège-GxABT : University of Liège, Gembloux Agro-Bio Tech
Gembloux, Belgium

ULiège-FVM: University of Liège, Faculty of Veterinary Medicine
Liège, Belgium

CRA-W: Walloon Agricultural Research Centre
Gembloux, Belgium

FBN: Leibniz Institute for Farm Animal Biology
Dummerstorf, Germany