Defining and using novel milk composition based heat stress resilience traits in the context of genomic selection for more robust dairy cows in Wallonia

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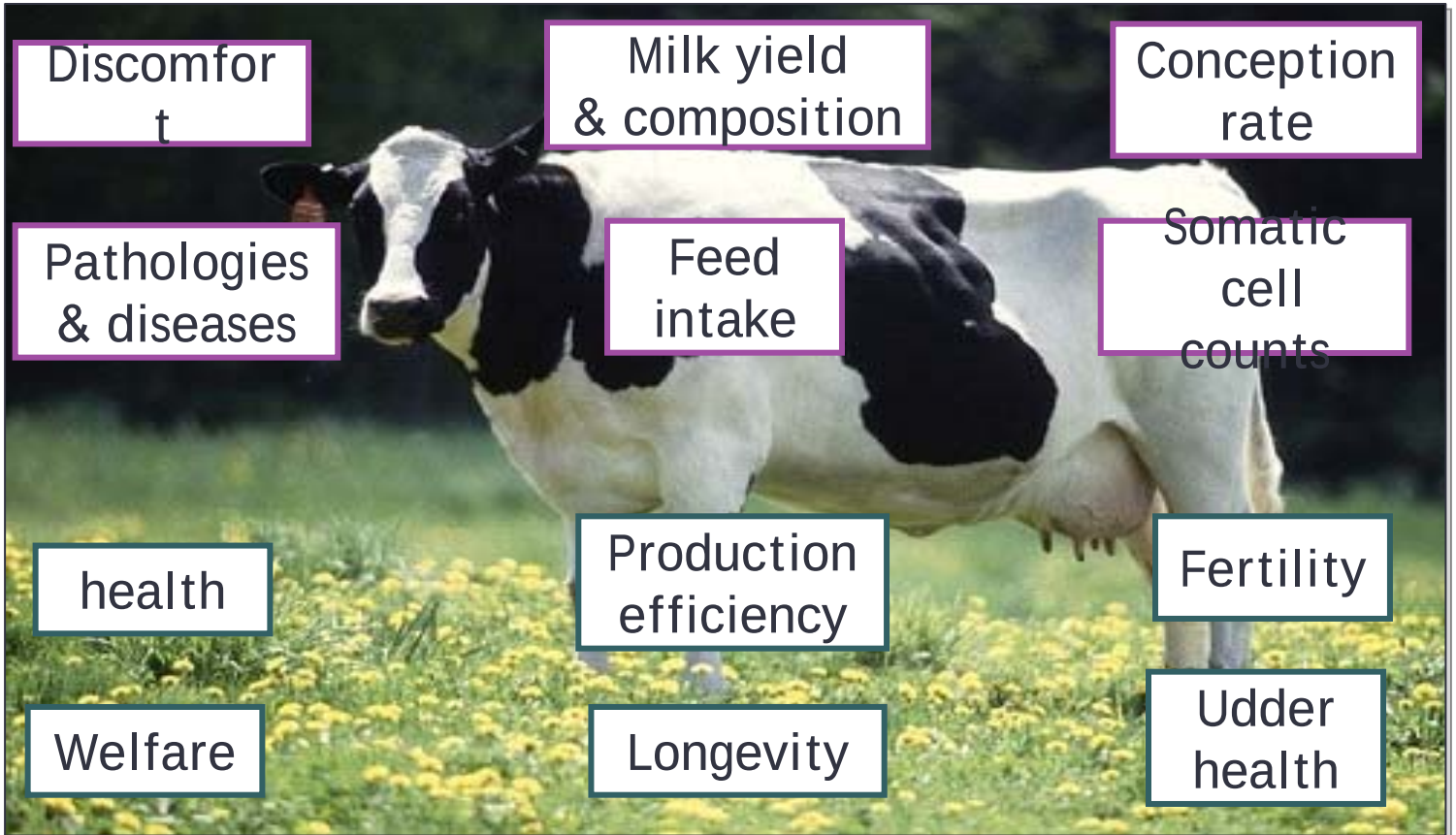
Heat stress (HS) linked to robustness

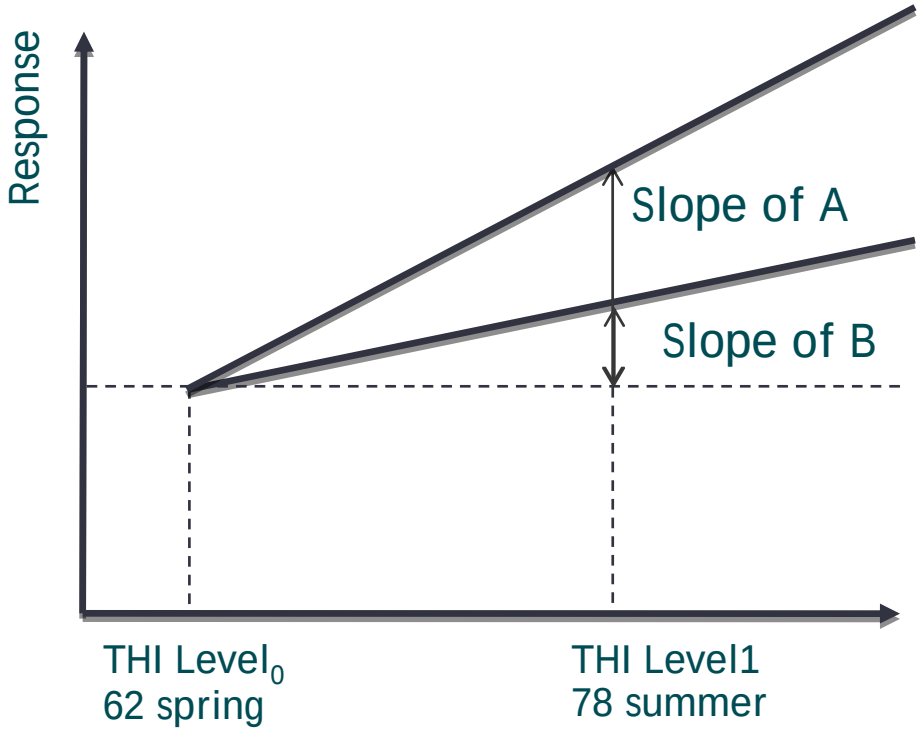


HS resilience: which phenotype?

- Direct measures adversity: Physiological status and invasive biomarkers

- Common method: Slope of production traits vs. THI (milk recording + meteorological data)

HS reaction norms due to THI



- Less reaction more resilience
- Slope A > Slope B

↓

Resilience A < Resilience B

Objectives

Innovative phenotypes

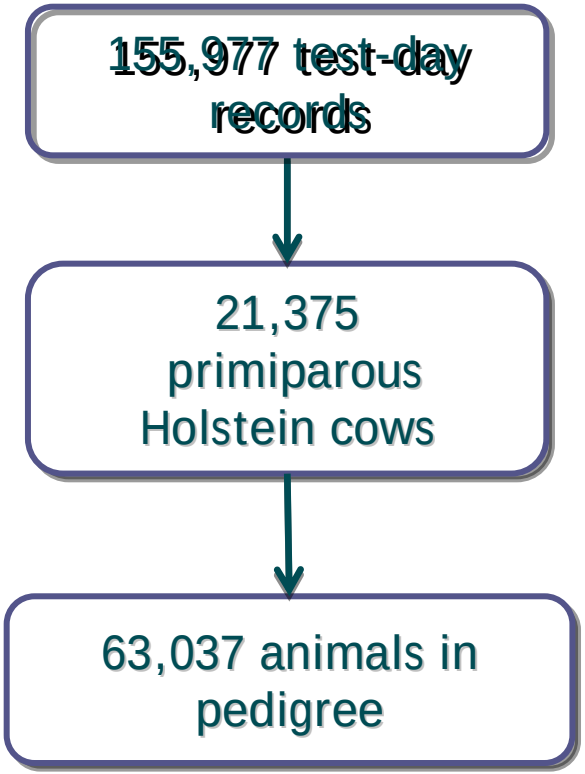
- Finest phenotypes for HS resilience?

Mid-infrared spectra (MIR) ?

Genomics

- Can genomics help to predict robustness at early stages?

Data


155,977 test-day records
21,375 primiparous Holstein cows
63,037 animals in pedigree

Traditional and novel milk traits

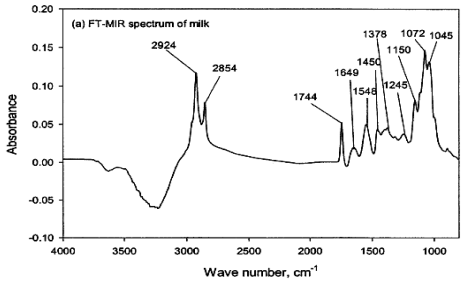
Milk samples

(milk payment, milk recording)

MIR analysis

Quantification:
30 major, minor and biomarker traits

Calibration equations



Raw data = MIR spectra

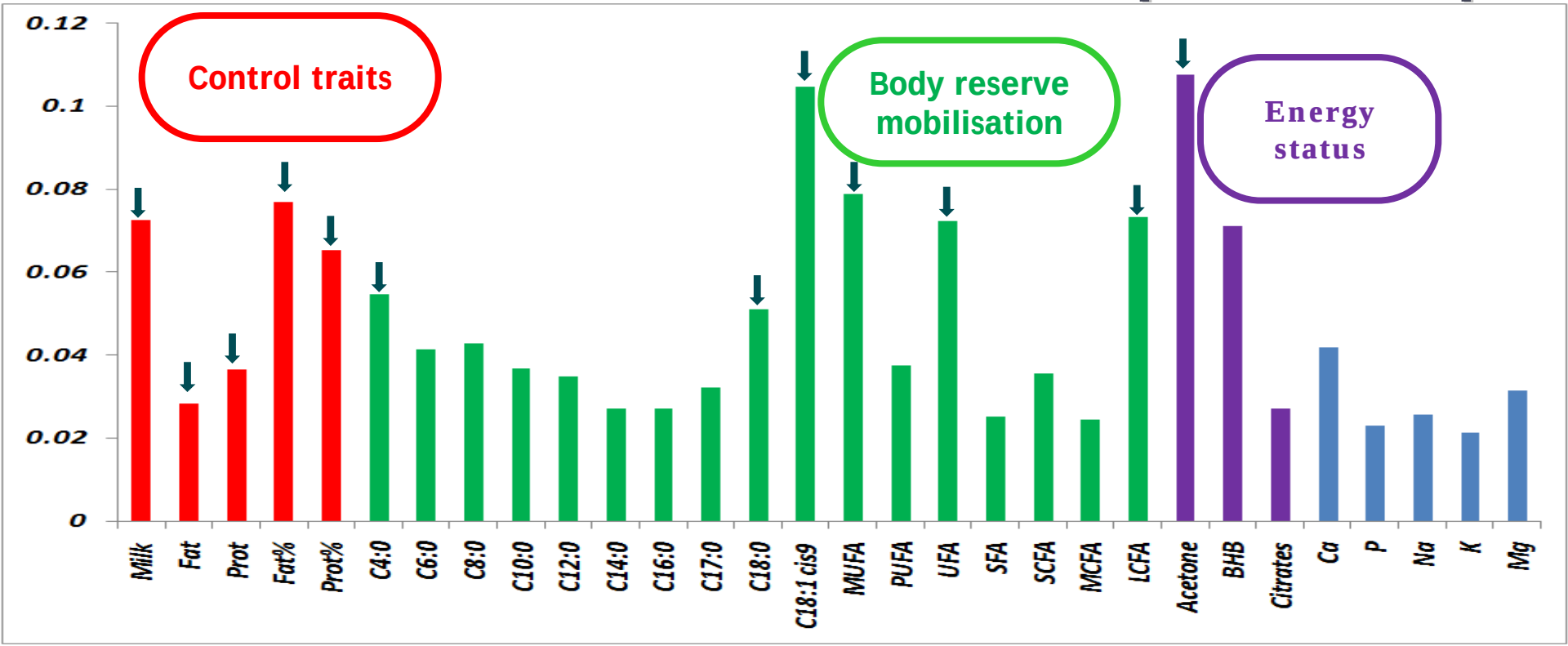
Reaction norm model

$$y_{ij} = \text{fixed effects} + a_{0_i} + t_{ij} * a_{HS_i} + p_{0_i} + t_{ij} * p_{HS_i} + e$$

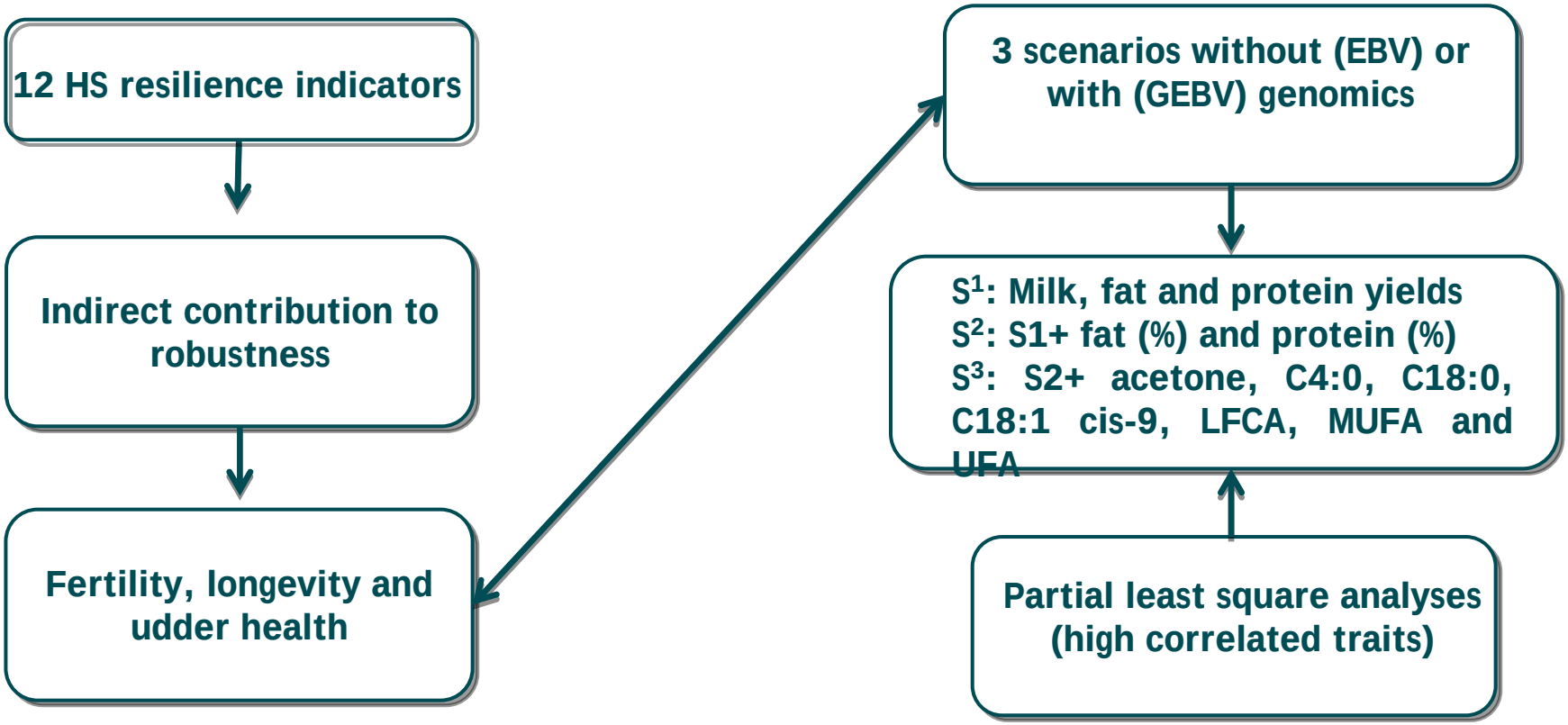
- y_{ij} = response j of animal i
- a_{0_i} and p_{0_i} : intercept (level)
- a_{HS_i} and p_{HS_i} : slope (reaction to THI)
- t_{ij} = THI

Slope-intercept variances ratio: magnitude of THI response of each trait

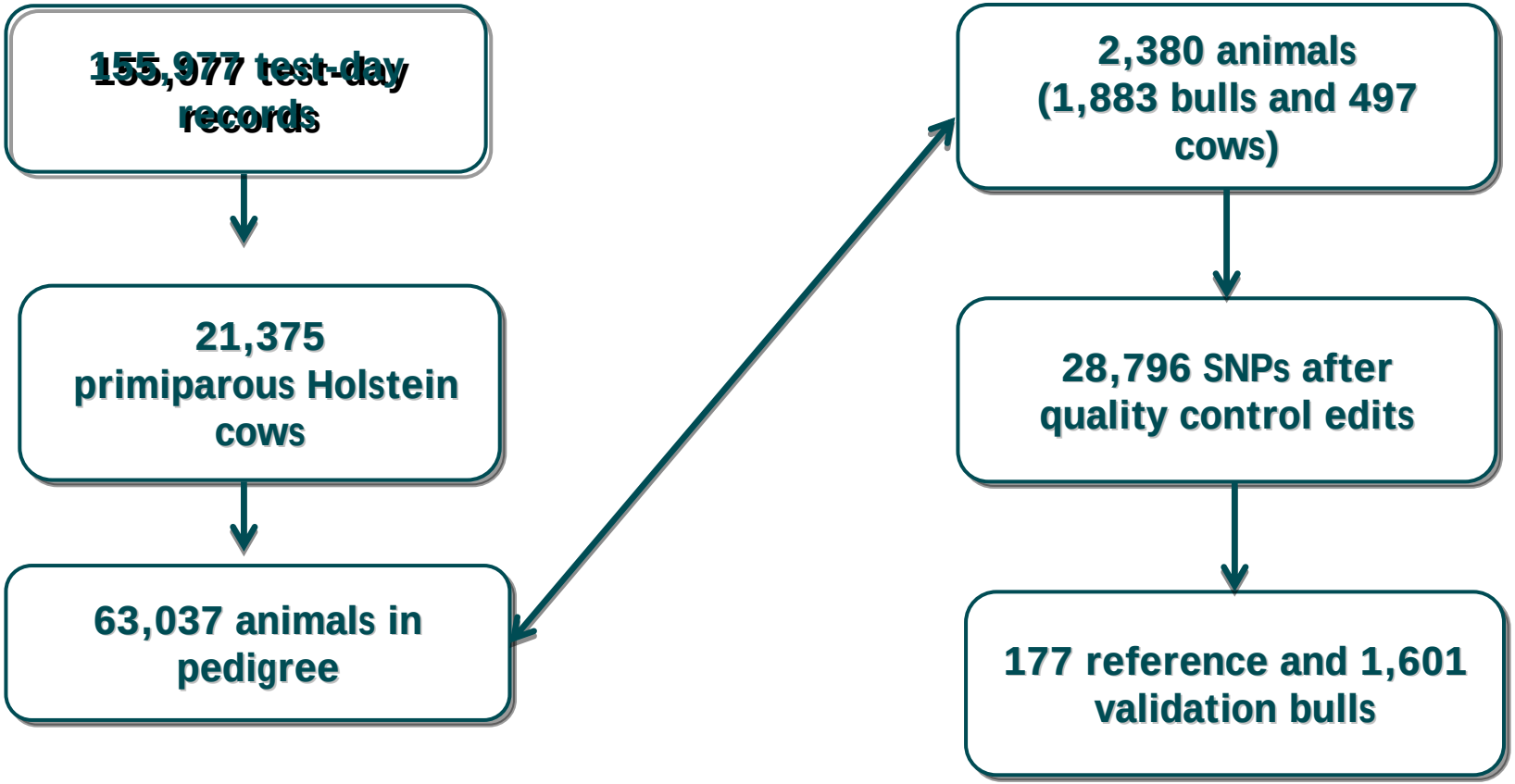
Traditional and novel milk traits: slope/intercept



Validation study

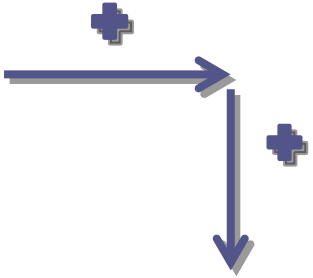


Genotypes


155,977 test-day records
21,375 primiparous Holstein cows
63,037 animals in pedigree
2,380 animals (1,883 bulls and 497 cows)
28,796 SNPs after quality control edits
177 reference and 1,601 validation bulls

Validation results

RT	Scenarios	EBV (r)	GEBV (r)
Fertility	S^1	0.28	0.31
	S^2	0.30	0.33
	S^3	0.44	0.46
Udder health	S^1	0.13	0.16
	S^2	0.14	0.16
	S^3	0.40	0.40
Longevity	S^1	0.31	0.31
	S^2	0.32	0.33
	S^3	0.39	0.39



S^1: Milk, fat and protein yield; S^2: S^1 + fat (%) and protein (%); S^3: S^2 + acetone, C4:0, C18:0, C18:1 cis-9, LFCA, MUFA and UFA

Take home messages

- Milk composition resilience heat stress traits as early indicators of robustness
- Genomics tends to lead to higher accuracies

Acknowledgments and disclaimer

GE PLUS
Genotype plus Environment
Integration for a more sustainable dairy production system

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement n° 613689

The views expressed in this publication are the sole responsibility of the author(s) and do not necessarily reflect the views of the European Commission.

Support of the Futurospectre Consortium * providing access to MIR data

*Walloon Breeding Association, CRA-W, Milk Committee and Uliége-GxABT

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