# A FOLLOW-UP ON BLOOD METABOLIC CLUSTERS IN DAIRY COWS

AARHUS UNIVERSITY
DEPARTMENT OF ANIMAL SCIENCE

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SESSION 5, 26 AUGUST 2019

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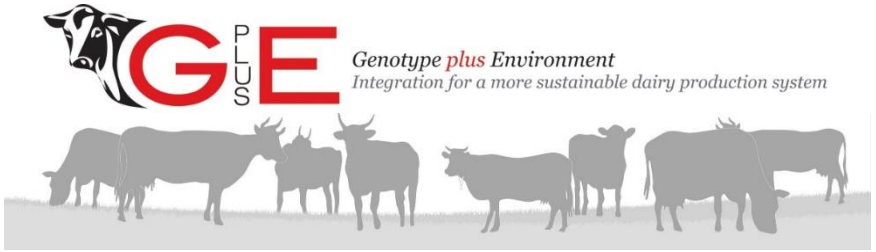
# BACKGROUND




- Results from GplusE, **www.gpluse.eu**
- Metabolic clusters based on **plasma glucose**, **BHB** (β-hydroxybutyrate) and **NEFA** (Non–Esterified Fatty Acids) and **serum IGF-1** (Insulin–like Growth Factor-1)
- Prediction by sets of milk biomarkers
  - MIR (mid-IR) spectra
  - IgG (immunoglobulin G) *N*-glycans
  - Milk metabolites and enzymes

*Animal* (2019), 13:3, pp 649–658 © The Animal Consortium 2018
doi:10.1017/S1751731118001751

animal

**Potential of milk mid-IR spectra to predict metabolic status of cows through blood components and an innovative clustering approach**

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J. Dairy Sci. 102:2631–2644
https://doi.org/10.3168/jds.2018-15533


**Prediction of metabolic clusters in early-lactation dairy cows using models based on milk biomarkers**

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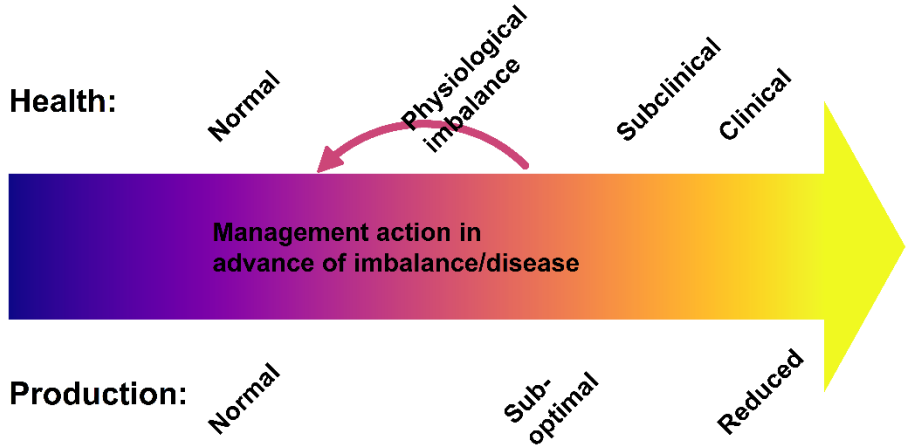
# OBJECTIVE

- Using data from a large Danish study
  - Follow-up on characteristics of the blood metabolic clusters in early lactation
    - Physiological imbalance
    - Energy balance (**EBAL**)
    - Energy corrected milk yield (**ECM**)
    - Components of the milk
      - Fat/protein ratio
      - Fat/lactose ratio
      - Citrate concentration

*Fra Memo forsøget på Ammitsbøl Skovgaard*

http://www.kfc-foulum.dk/artikler/12_publikation/nyhedsbrev8.pdf



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# MATERIAL

- Experiment 1996-2001 on a Danish research farm, Ammitsbøl Skovgaard
- 321 cows, in total 610 lactations (1st to 5th): 108 Danish Red, 130 Danish Holstein and 83 Jersey cows
- Randomised to low or normal energy density TMR
- Measures **25** and **74** days after calving:
  - **Plasma glucose**, **BHB**, **NEFA** and **IGF-1**
  - **Milk fat**, **protein**, **lactose** and **citrate**
  - Yield, feed, body weight and derivatives: **EBAL** and **ECM**

ELSEVIER

Livestock Production Science 79 (2003) 119–133

LIVESTOCK PRODUCTION SCIENCE

www.elsevier.com/locate/livprodsci

Influence of breed, parity, and stage of lactation on lactational performance and relationship between body fatness and live weight

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Available online at www.sciencedirect.com

SCIENCE DIRECT

Domestic Animal Endocrinology 29 (2005) 294–304

DOMESTIC ANIMAL ENDOCRINOLOGY

www.journals.elsevierhealth.com/periodicals/dae

To what extent do variabilities in hormones, metabolites and energy intake explain variability in milk yield?

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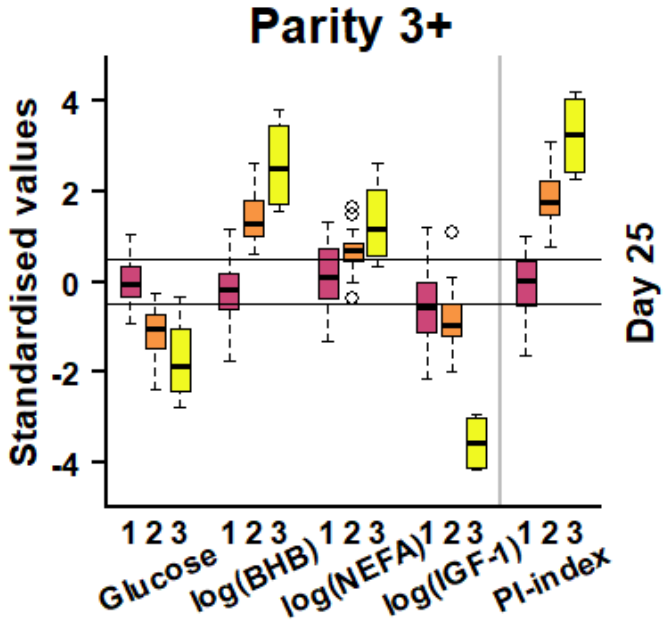
# METHODS

- Metabolic clusters by k-means clustering (k=3) within parity and day
- Using plasma glucose, log(BHB), log(NEFA) and log(IGF-1) standardised within breed and parity (1, 2 and 3+)
- Boxplots of various components
- Physiological imbalance (**PI**):

  **low glucose, high BHB and high NEFA**
- **PI-index** (modified from Moyes et al, 2013, J Dairy Sci 96: 3599-3610):

$$\frac{[\log(NEFA)] + [\log(BHB)] - [Glucose]}{\sqrt{3}}$$

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Animal Feed Science and Technology
126 (2006) 175–213

ANIMAL FEED SCIENCE AND TECHNOLOGY

www.elsevier.com/locate/anifeedsci

Feeding- and management-related diseases in the transition cow
Physiological adaptations around calving and strategies to reduce feeding-related diseases☆

K.L. Ingvartsen*

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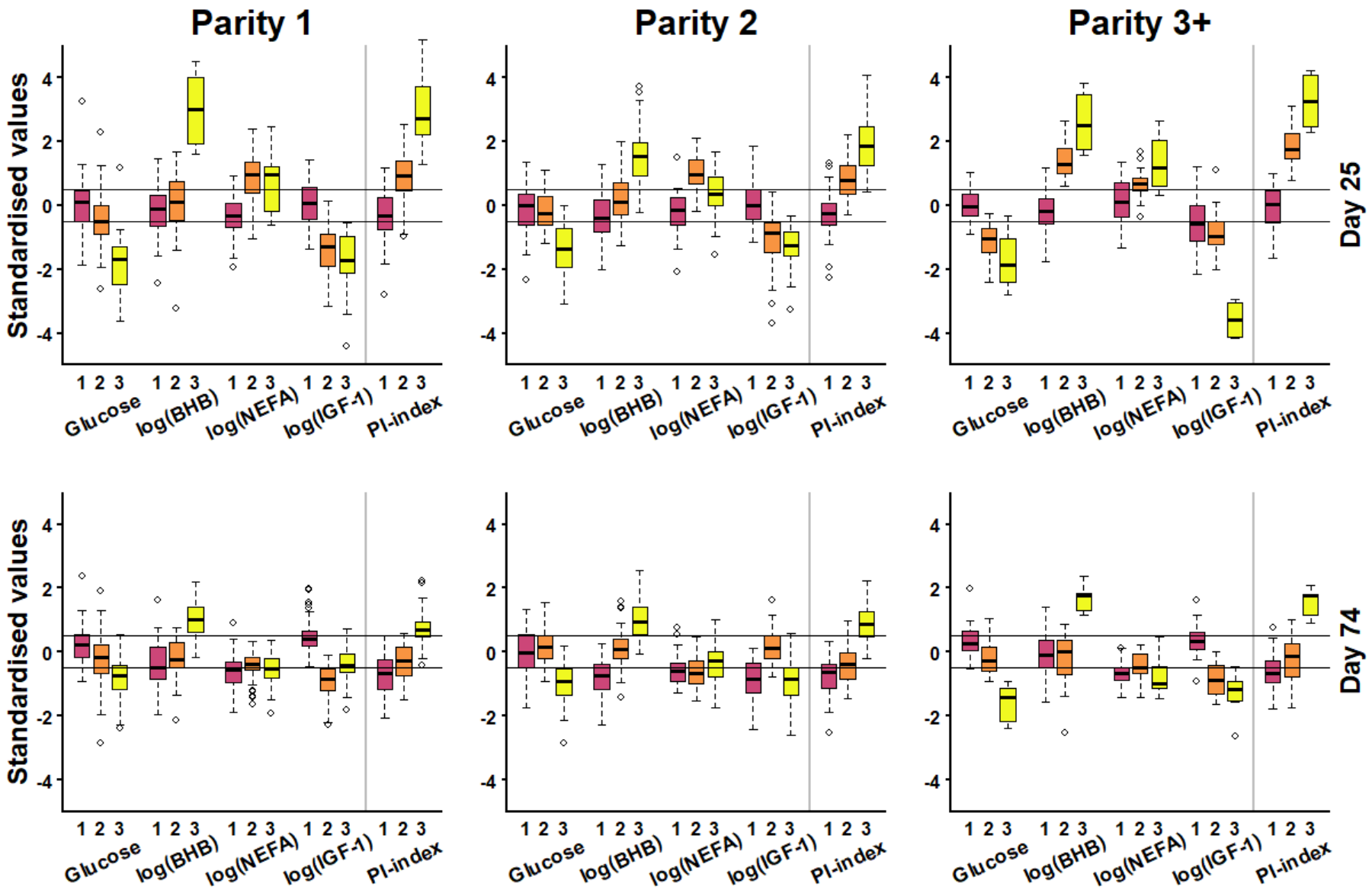
# RESULTS

- Physiological imbalance:
  - low glucose
  - high NEFA
  - high BHB
- PI-index

$$\frac{[\log(NEFA)] + [\log(BHB)] - [Glucose]}{\sqrt{3}}$$

- PI-index and IGF-1







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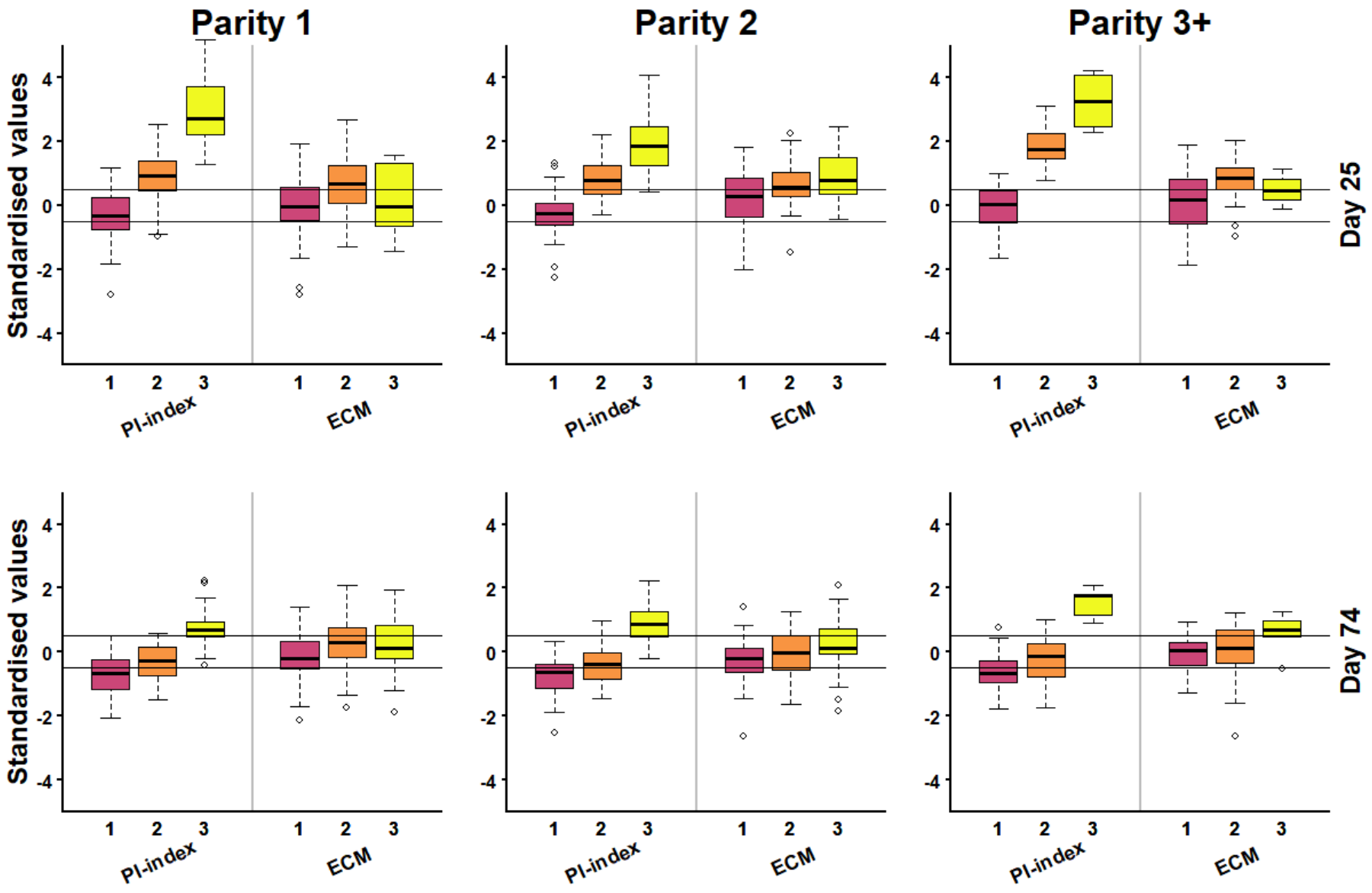
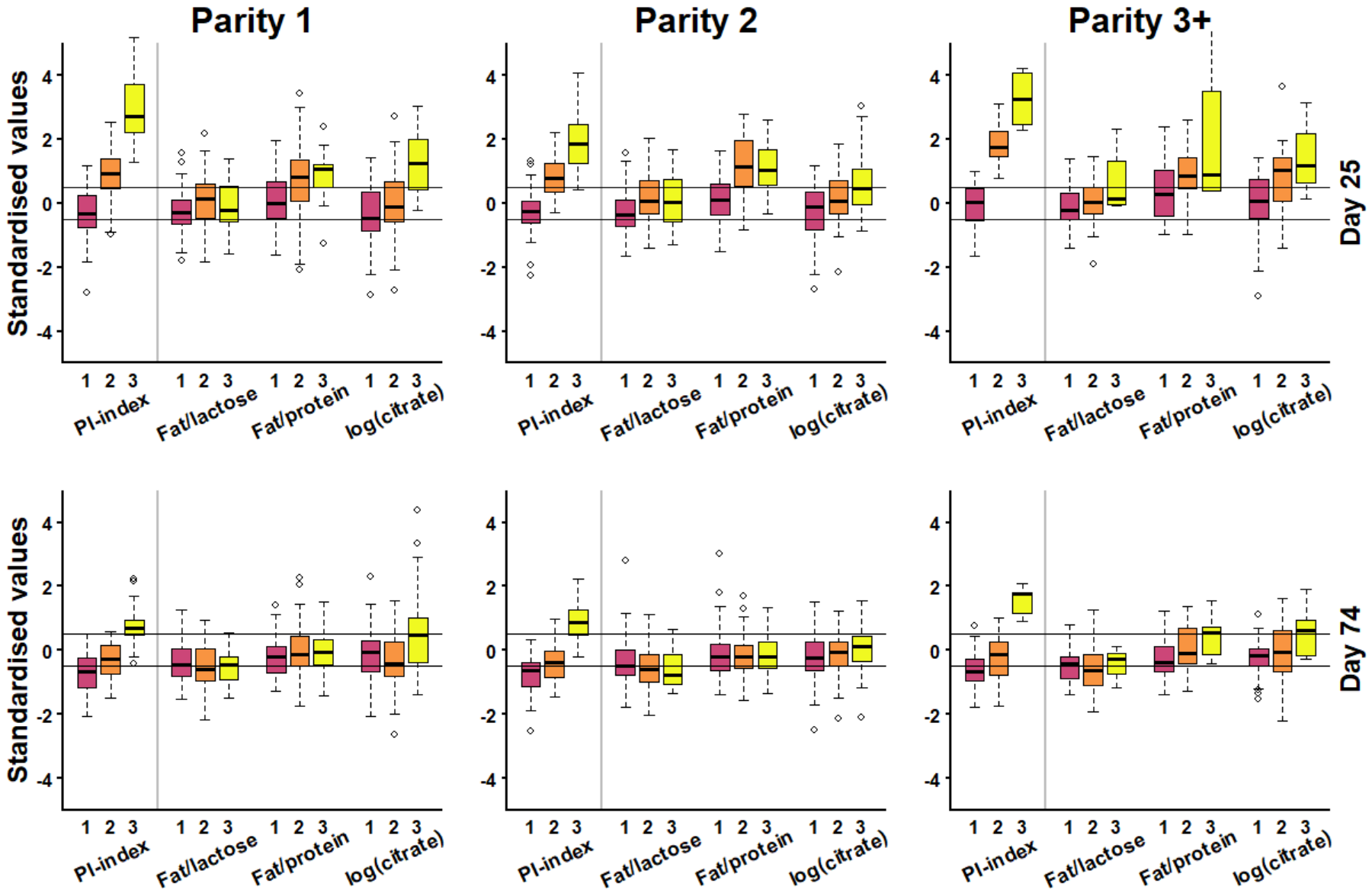
# RESULTS

- **ECM** (energy corrected milk yield)



# RESULTS

- Fat/lactose ratio
- Fat/protein ratio
- Citrate in milk

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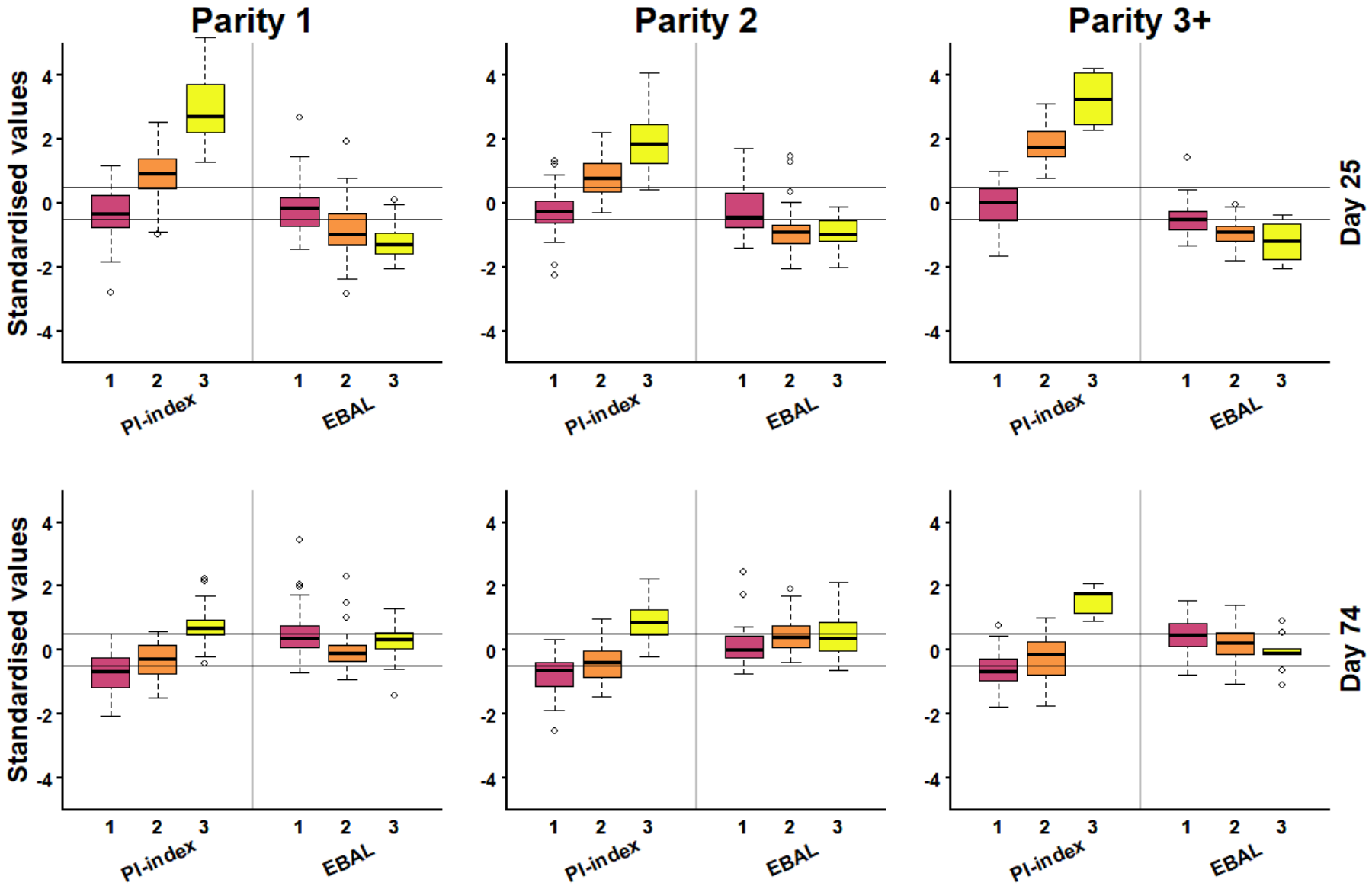
# RESULTS

- Energy balance

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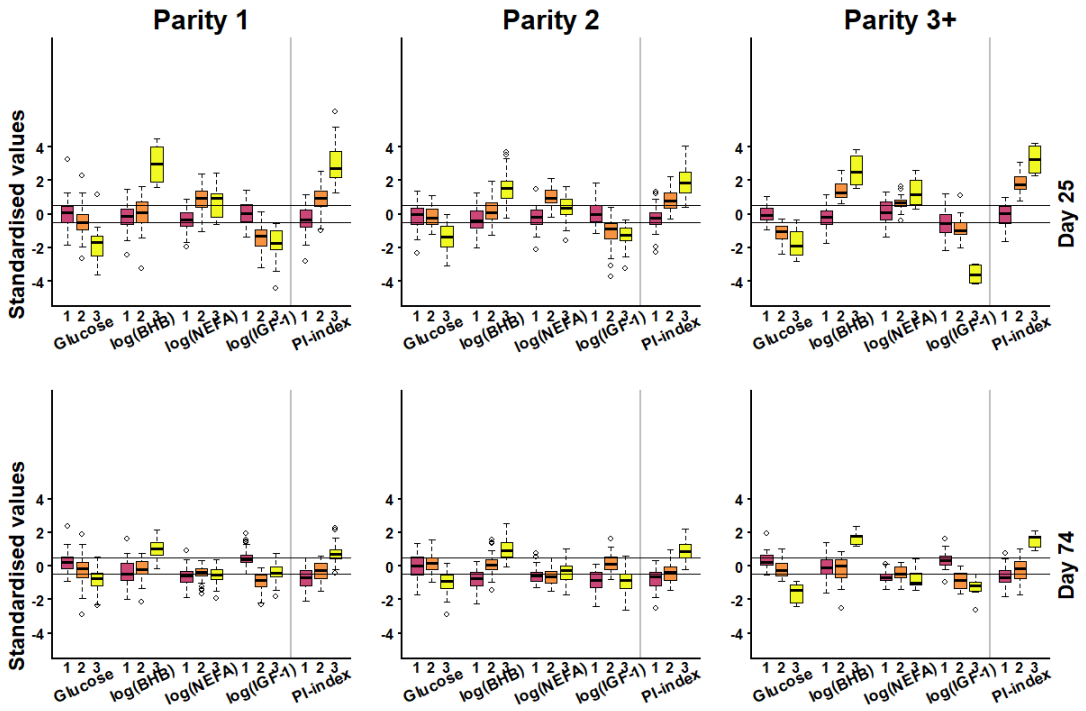
# RESULTS

- Changes from day 25 to 74

| Parity 1 (row pct) | | Day 74 | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | N |
| Day 25 | 1 | 58.1% | 21.0% | 21.0% | 62 |
| | 2 | 14.8% | 47.5% | 37.7% | 61 |
| | 3 | 7.7% | 38.5% | 53.8% | 13 |
| | N | 46 | 47 | 43 | 136 |

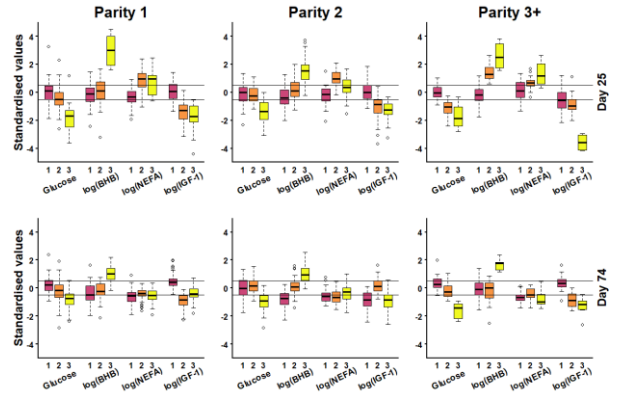


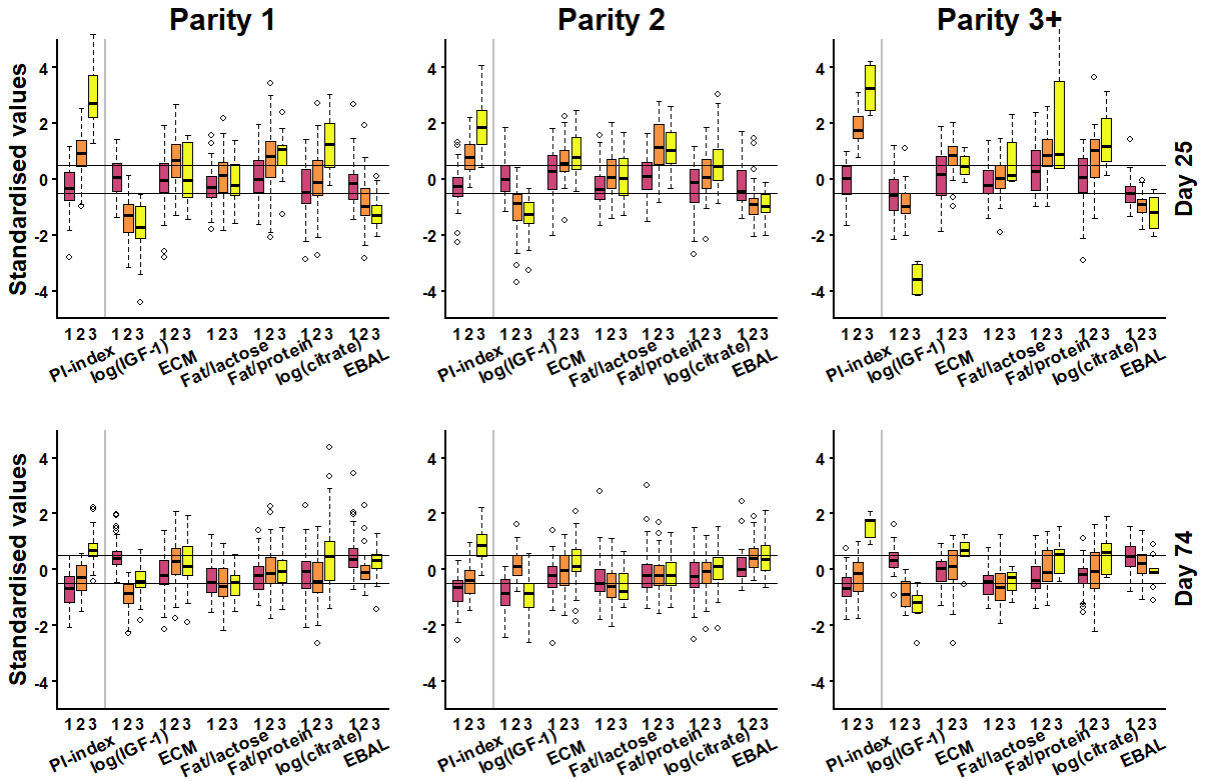

| Parity 2 (row pct) | | Day 74 | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | Sum |
| Day 25 | 1 | 16.7% | 59.5% | 23.8% | 42 |
| | 2 | 31.1% | 51.1% | 17.8% | 45 |
| | 3 | 19.4% | 33.3% | 47.2% | 36 |
| | N | 28 | 60 | 35 | 123 |

| Parity 3+ (row pct) | | Day 74 | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | N |
| Day 25 | 1 | 56.3% | 37.5% | 6.3% | 32 |
| | 2 | 50.0% | 33.3% | 16.7% | 30 |
| | 3 | 25.0% | 50.0% | 25.0% | 4 |
| | N | 34 | 24 | 8 | 66 |

# CONCLUSION

- Early in lactation: clusters of cows showing strong sign of physiological imbalance (PI)
- In early lactation IGF-1 is strongly linked to PI but this association becomes weaker later in lactation and the segregation in PI-index is more clear
- Physiological imbalance is not due to high ECM – but more likely difficulties in adapting to lactation
- Imbalanced cows had higher citrate content and fat/protein ratio but not fat/lactose ratio; indicating relationship to fat mobilisation and metabolism







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**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.

# Thank you for your attention


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