Blood metabolic biomarkers predicted from milk spectra are heritable in Holstein transition cows

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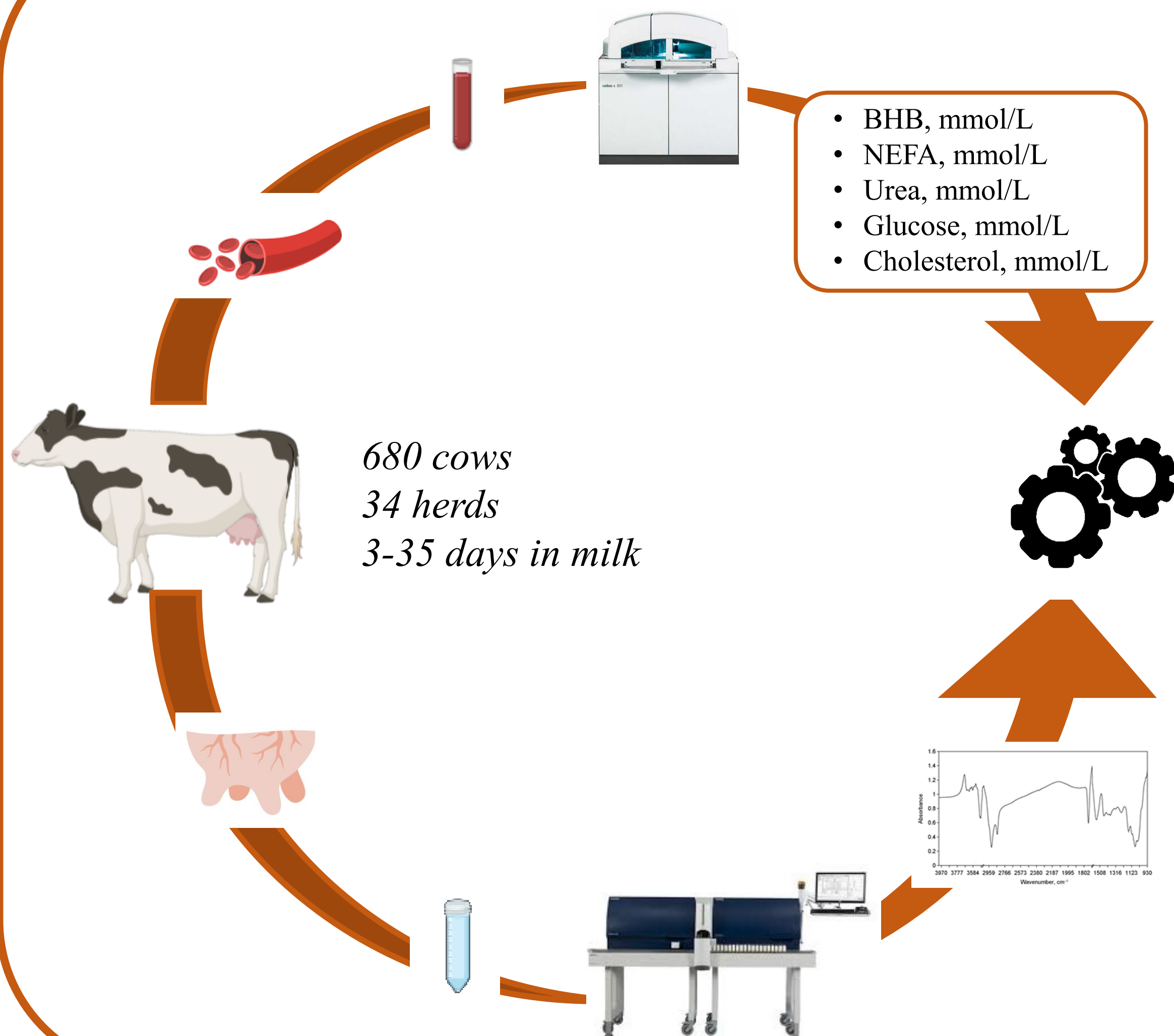
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OBJECTIVE

Estimate heritability of blood energy profile traits (BHB, NEFA, glucose, cholesterol and urea) predicted from milk mid-infrared spectra in Italian Holstein cows in early lactation to evaluate potential use for breeding.
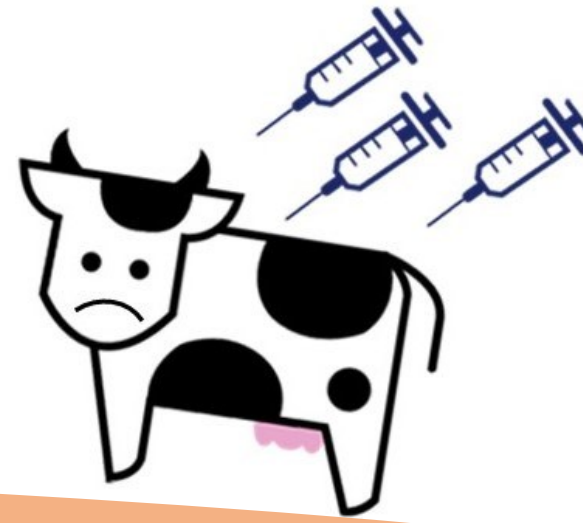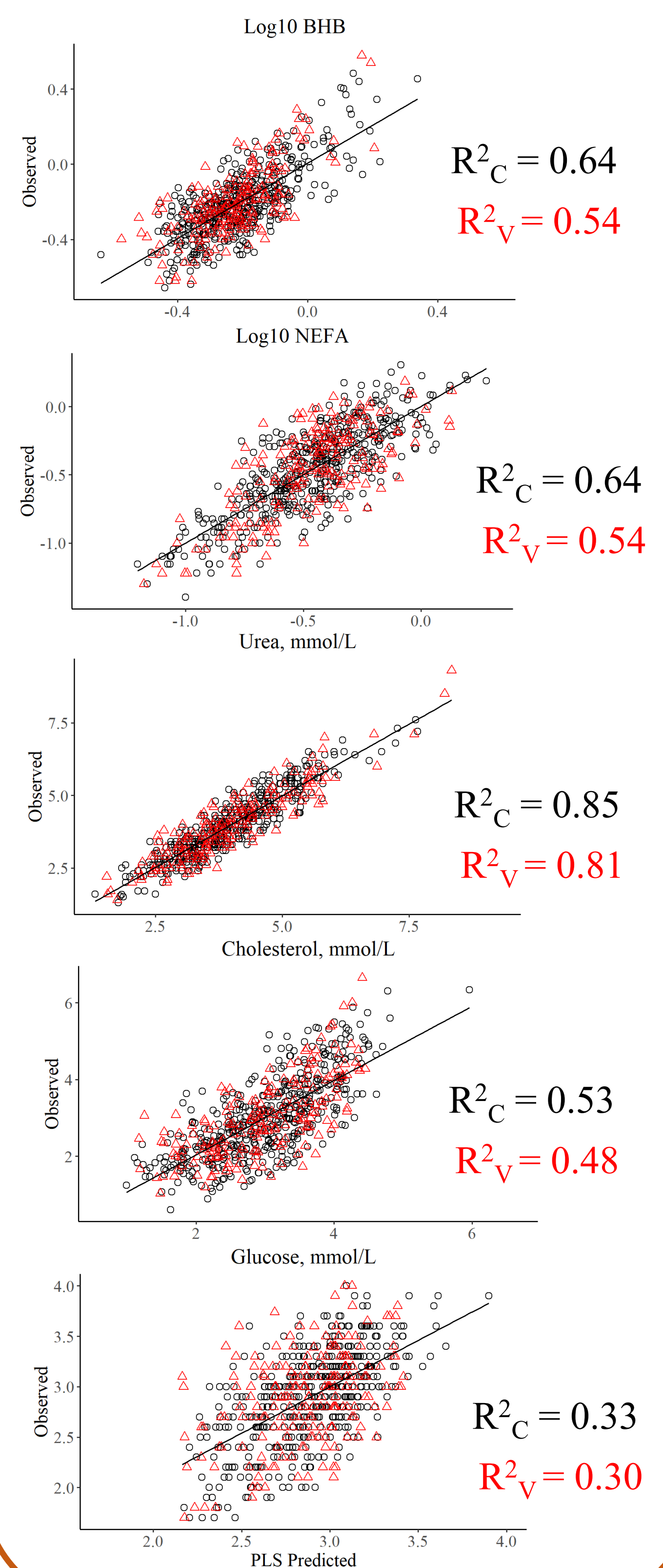
BACKGROUND

✓ Blood metabolic profile provide useful information about cows' metabolic status, especially in early lactation.
✓ Determining hematic parameters is however costly and requires invasive blood samplings.

DATASET 1 - Model development

- BHB, mmol/L
- NEFA, mmol/L
- Urea, mmol/L
- Glucose, mmol/L
- Cholesterol, mmol/L

680 cows
34 herds
3-35 days in milk

MODELS DEVELOPMENT VIA PARTIAL LEAST SQUARE REGRESSION

Mid-infrared predictions vs observed values (● calibration set, ▲ validation set).

Log10 BHB — $R^2_C = 0.64$, $R^2_V = 0.54$
Log10 NEFA — $R^2_C = 0.64$, $R^2_V = 0.54$
Urea, mmol/L — $R^2_C = 0.85$, $R^2_V = 0.81$
Cholesterol, mmol/L — $R^2_C = 0.53$, $R^2_V = 0.48$
Glucose, mmol/L — $R^2_C = 0.33$, $R^2_V = 0.30$

DATASET 2 – Genetic study

Models applied to the independent spectra (PREDICTION SET):
8,277 Italian Holstein cows
374 herds
3-35 days in milk

Heritability and coefficient of additive genetic variation (CV$_a$).

Trait	Heritability	CV$_a$, %
BHB (log$_{10}$-transformed)	0.13 (0.03)	28.81
NEFA (log$_{10}$-transformed)	0.03 (0.01)	10.14
Urea, mmol/L	0.04 (0.02)	10.36
Cholesterol, mmol/L	0.07 (0.03)	4.39
Glucose, mmol/L	0.08 (0.03)	3.14

Data points of prediction set.
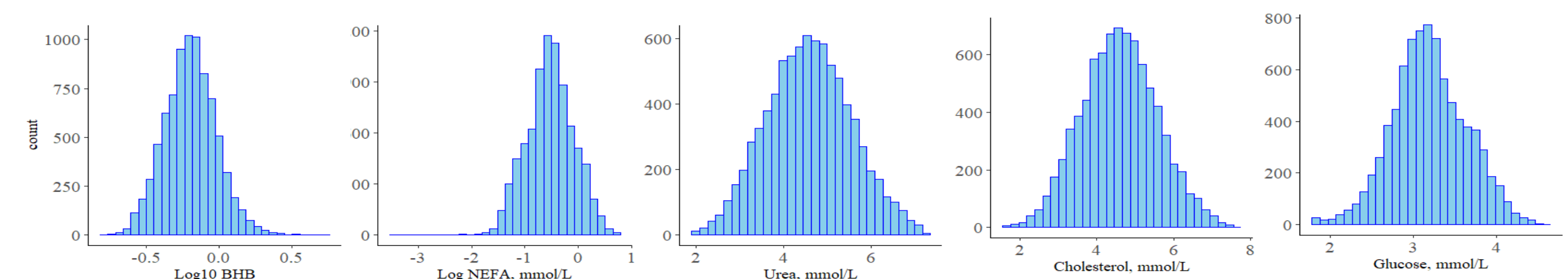
CONCLUSIONS

➢ Blood metabolic parameters, especially BHB, are heritable and variable in the Italian Holstein population.
➢ Predictions can be **used to guide genetic strategies** towards a reduced incidence of/greater resistance to metabolic diseases in the transition period.