Genetic evaluation for ketosis

SABRE-TP workshop

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Ketosis: Clinical signs

- Metabolic disease in (high-yielding) dairy cows
- Clinical Signs:
  - Specific:
    - Elevated concentration of ketone bodies (acetone, acetoacetate, β-hydroxybutyrate (BHB)) in blood
  - Non-specific:
    - Digestive disorders
    - Loss of appetite
    - Decreased milk production
    - Rapid loss of body condition

# Ketosis: Negative energy balance
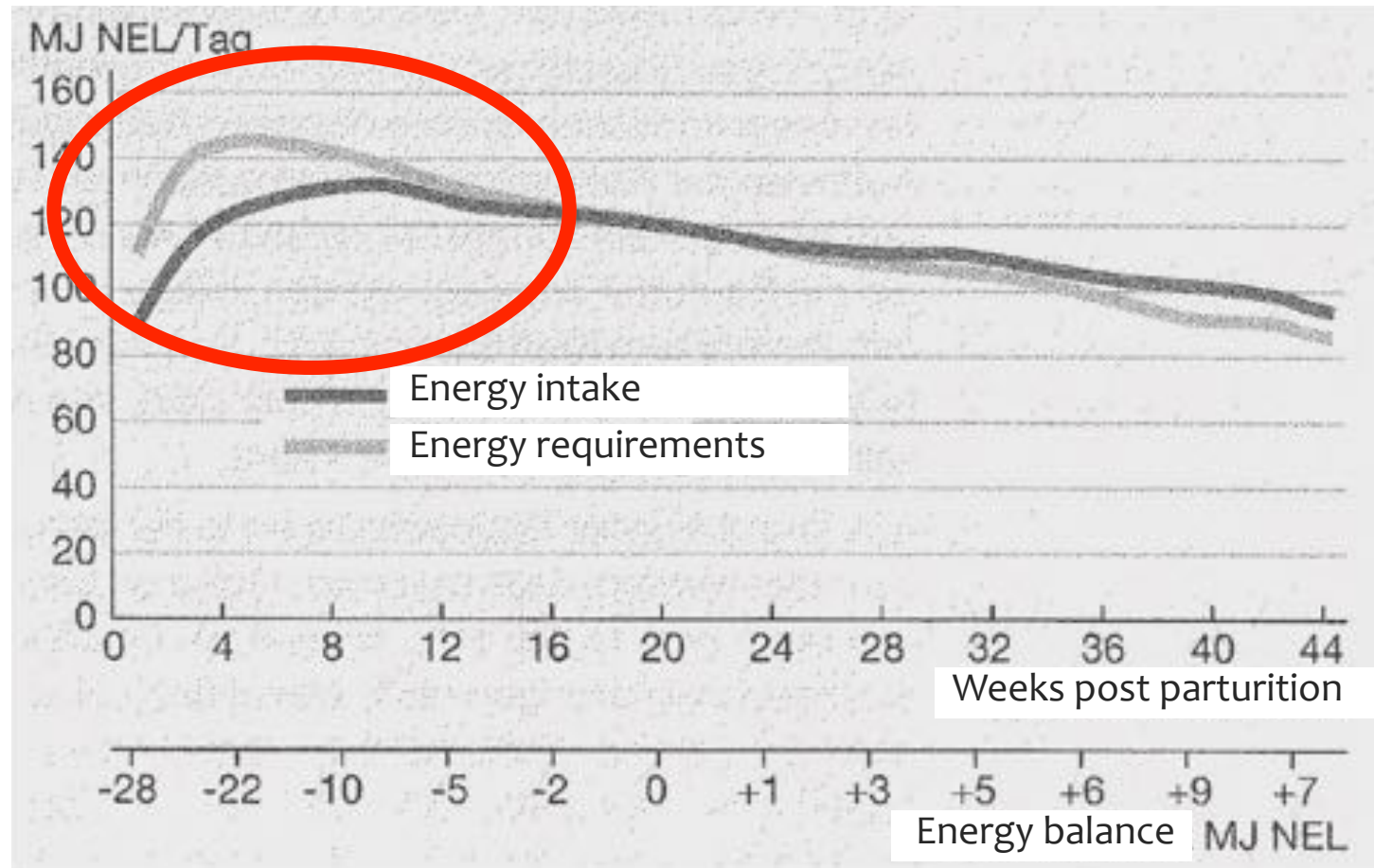
Source: Jans F., Kessler J., Münger A., Schori F., Schlegel P., 2017. Fütterungsempfehlungen für die Milchkuh. In: Fütterungsempfehlungen für Wiederkäuer (Grünes Buch), Kapitel 7., Hrsg. Agroscope, Posieux.

Ketosis

- Mobilization of nonestrified fatty acids (NEFA) from adipose tissue

- In the liver NEFAs are converted to glucose or - when oxalacetate becomes limiting for the Kreb's cycle - to ketone bodies.

- NEFA ⬆

- Acetone ⬆

- β-Hydroxybutyrate (BHB) ⬆

Ketosis: Situation in CH

Number of diagnoses per year for selected diseases
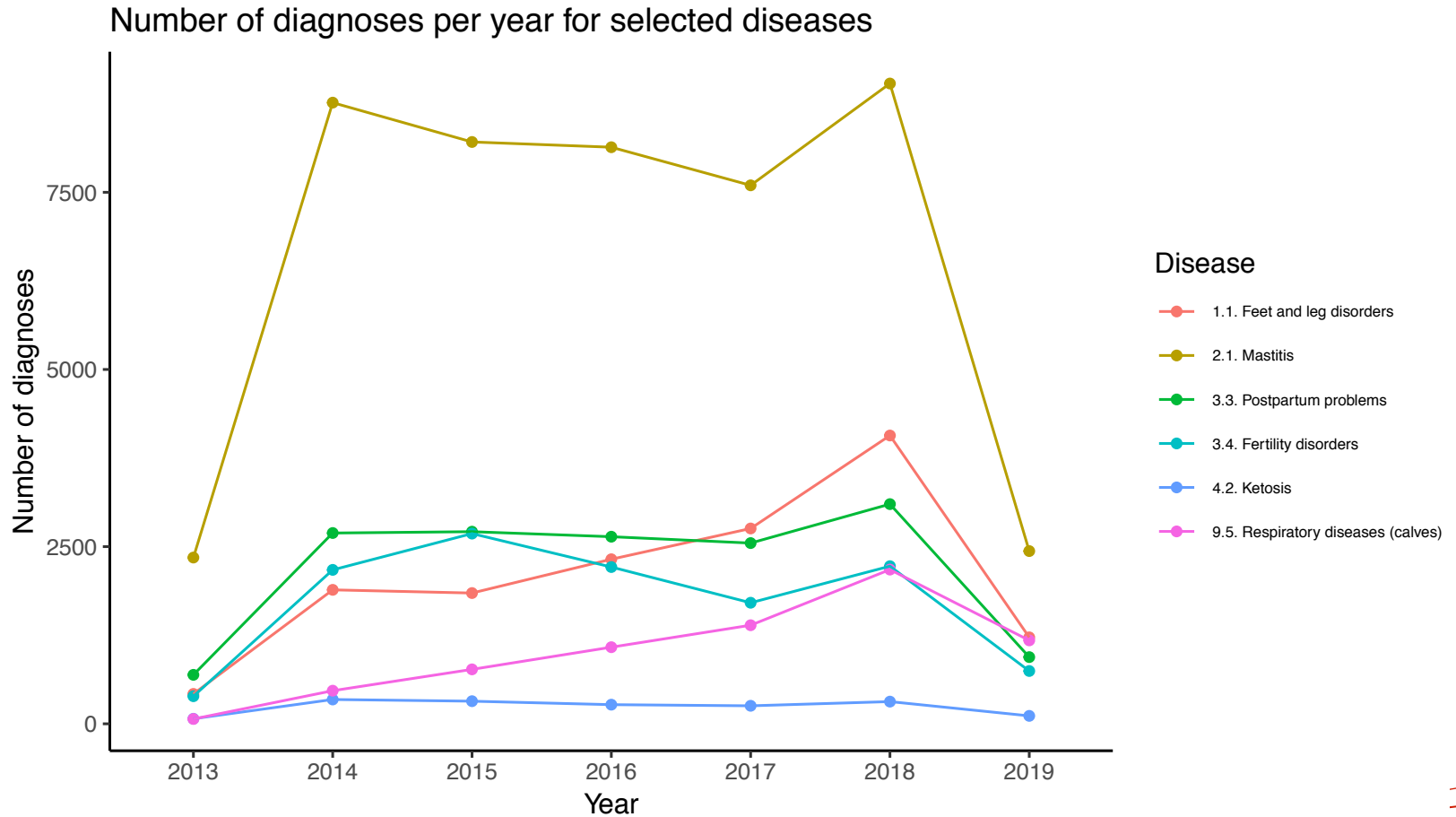
Ketosis: Situation in CH

- Few cases of ketosis recorded

- We assume that only severe cases (intervention by veterinarian and use of drugs) have been recorded

- Prevention is good (?)

- It is assumed that sub-clinical ketosis is more abundant and that it is related to other diseases and to fertility disorders

- **Selection against susceptibility to ketosis may be advantageous for the populations**

Data: Sources

- Data from milk recording (milk, fat, protein, lactose, urea …)
- Health data recording

Data: Traits

CombiFoss

AutoAnalyzer
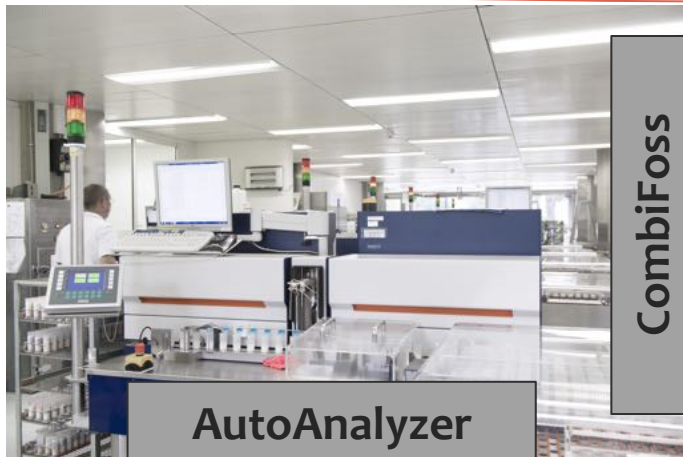
Acetone in milk (mmol/l)

BHB in milk (mmol)
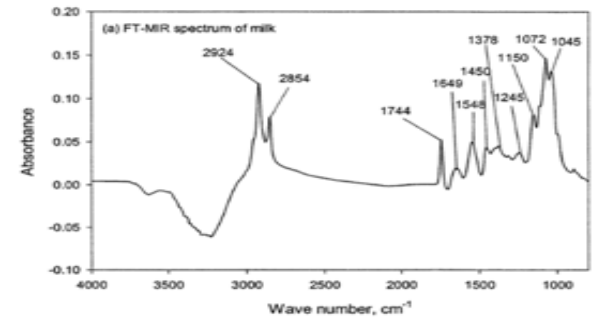
MIR milk spectra

Acetone in milk (mg/l)

Acetone in milk (mmol/l)

BHB in blood (mmol/l)

NEFA in blood (mmol/l)

OptiMIR

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UNIVERSITÄT BERN

EMR

Veterinary Physiology

QUALITAS

Data: Traits

- Diagnoses of ketosis

- BHB in milk (FOSS) (mmol/l)
- Acetone in milk (FOSS) (mmol/l)
- Acetone in milk (AutoAnalyzer) (mg/l)
- Acetone in milk (EMR) (mmol/l)
- BHB in blood (EMR) (mmol/l)
- NEFA in blood (EMR) (mmol/l)

Which traits shall we use in the GE?

- Hypotheses:
  - Measurements are higher before a ketosis event than after
  - Measurements are higher in earlier lactation stages than in later
  - Measurements are higher in pure dairy breeds than in dual-purpose breeds

Data from Braunvieh Schweiz; Trait: Acetone in milk (AutoAnalyzer) (mg/l); Milk recording within 10 days befor or after ketosis event indicated by lines
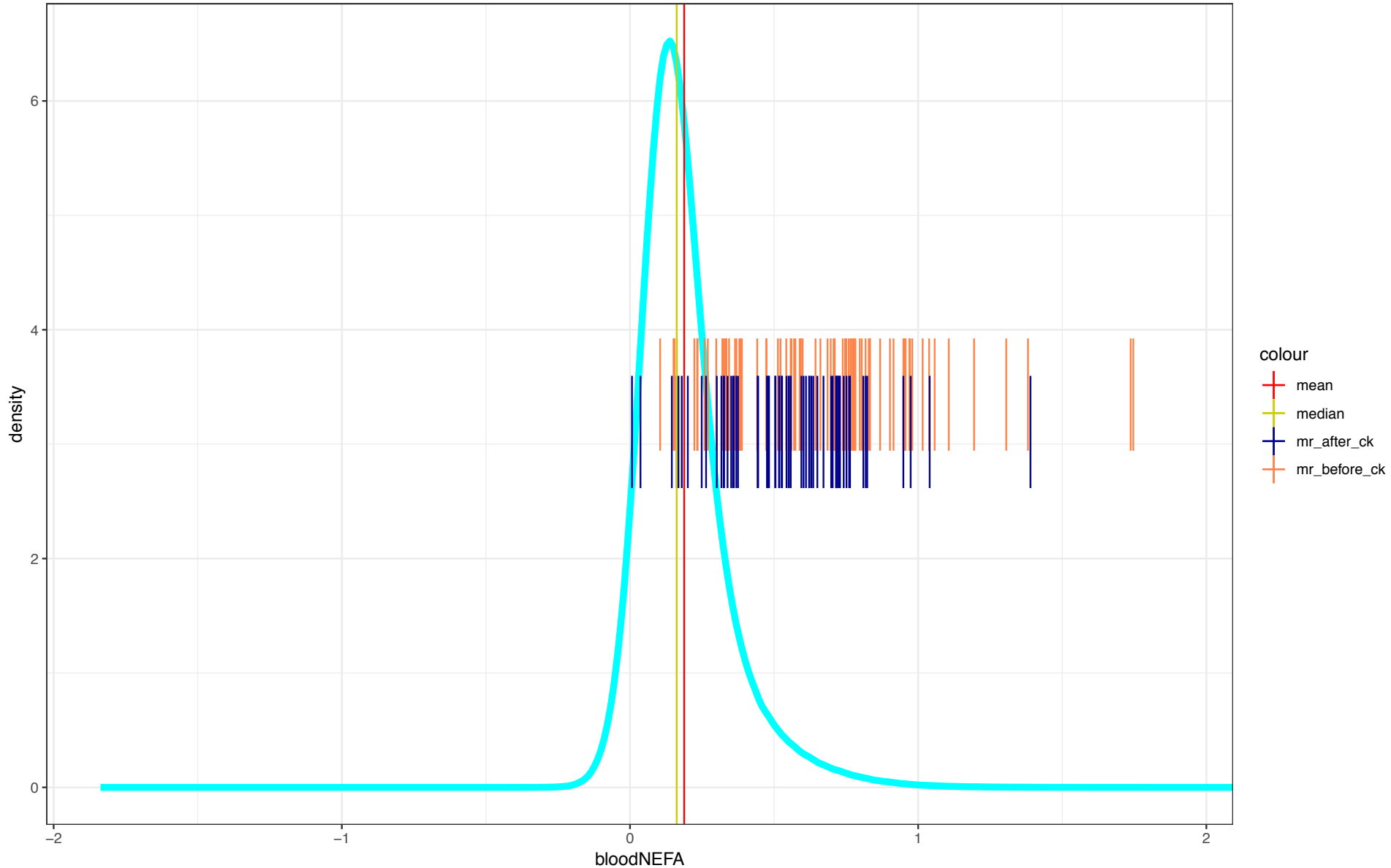
Distribution of trait aa_acetone
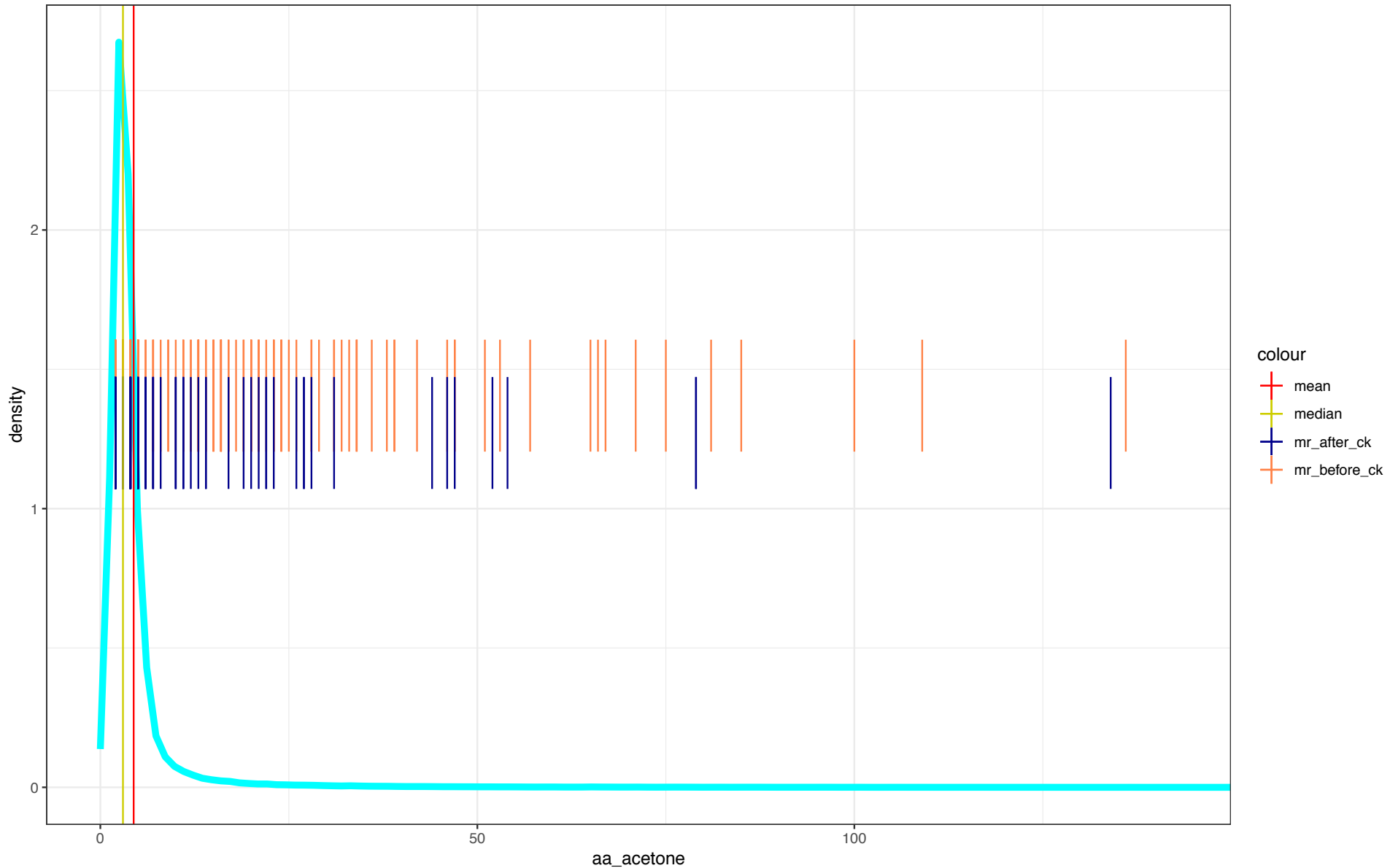
Number of observations: 538060; Number of observations before a reported ketosis event: 114; Number of observations after a reported ketosis event: 98

Data from Holstein Switzerland and swissherdbook; Trait: NEFA in blood (EMR) (mmol/l); Milk recording within 10 days befor or after ketosis event indicated by lines

Distribution of trait bloodNEFA

Number of observations: 7695114; Number of observations before a reported ketosis event: 79; Number of observations after a reported ketosis event: 64

Data from Holstein Switzerland and swissherdbook; Trait: BHB in milk (FOSS) (mmol/l); DIM-classes start at DIM 5 and class-width is 10 days
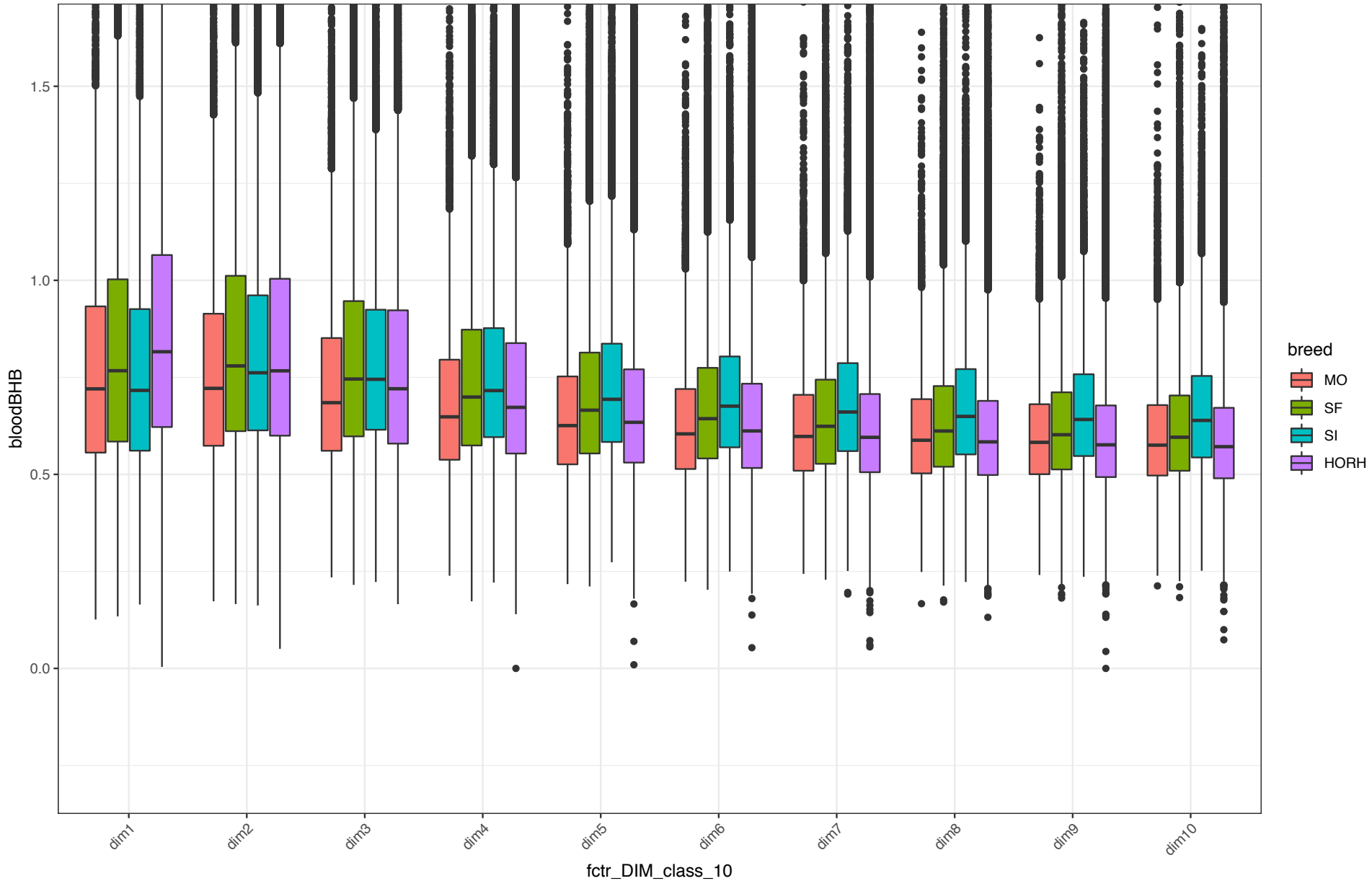
Box−Plots for trait   foss_bhb   separated according to DIM−classes (width 10 days)

Breed: HORH
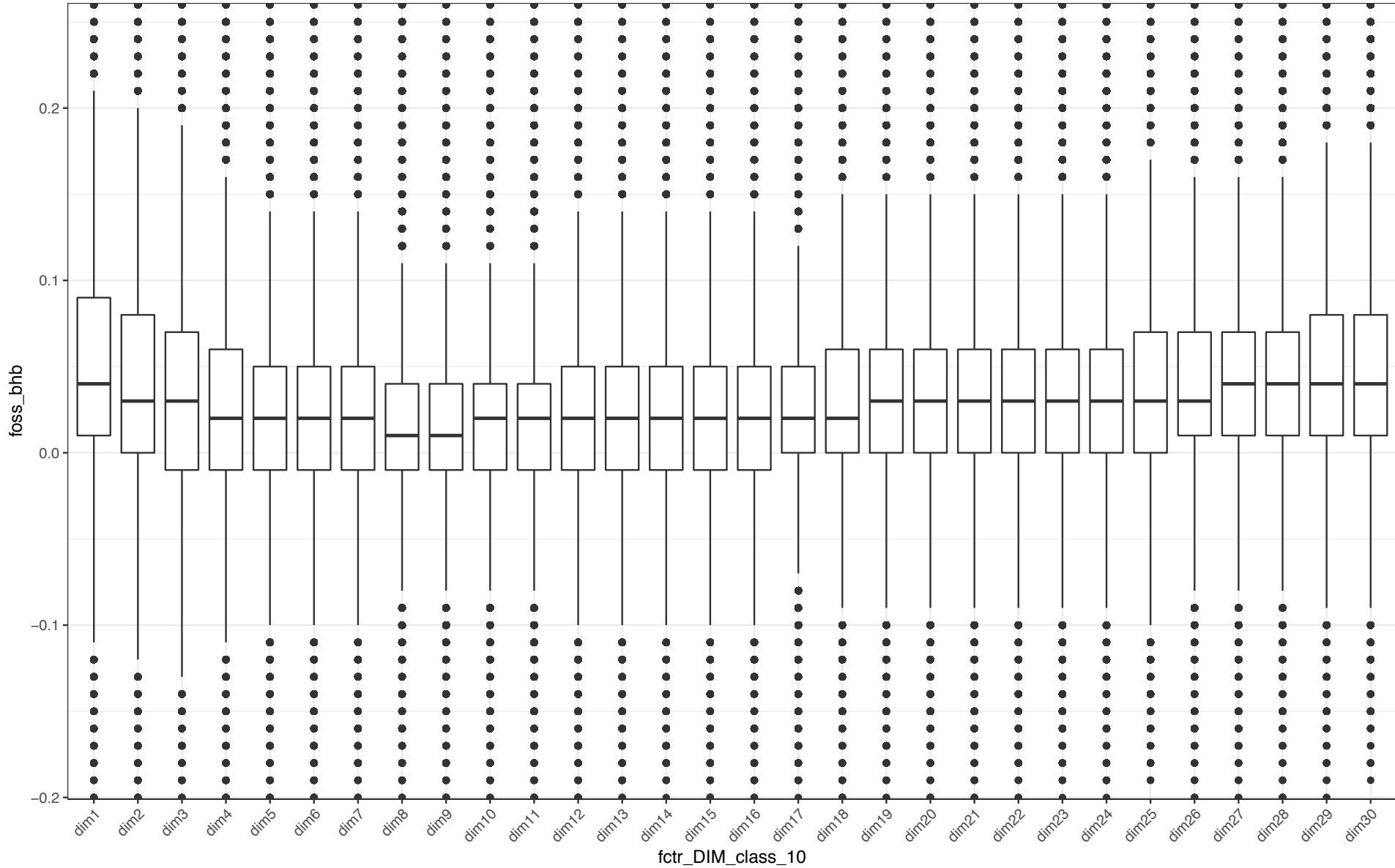
Data from Holstein Switzerland and swissherdbook; Trait: BHB in blood (EMR) (mmol/l); DIM-classes start at DIM 5 and class-width is 10 days

Box–Plots for trait bloodBHB separated according to DIM–classes (width 10 days)

Data from Braunvieh Schweiz; Trait: NEFA in blood (EMR) (mmol/l); DIM-classes start at DIM 5 and class-width is 10 days
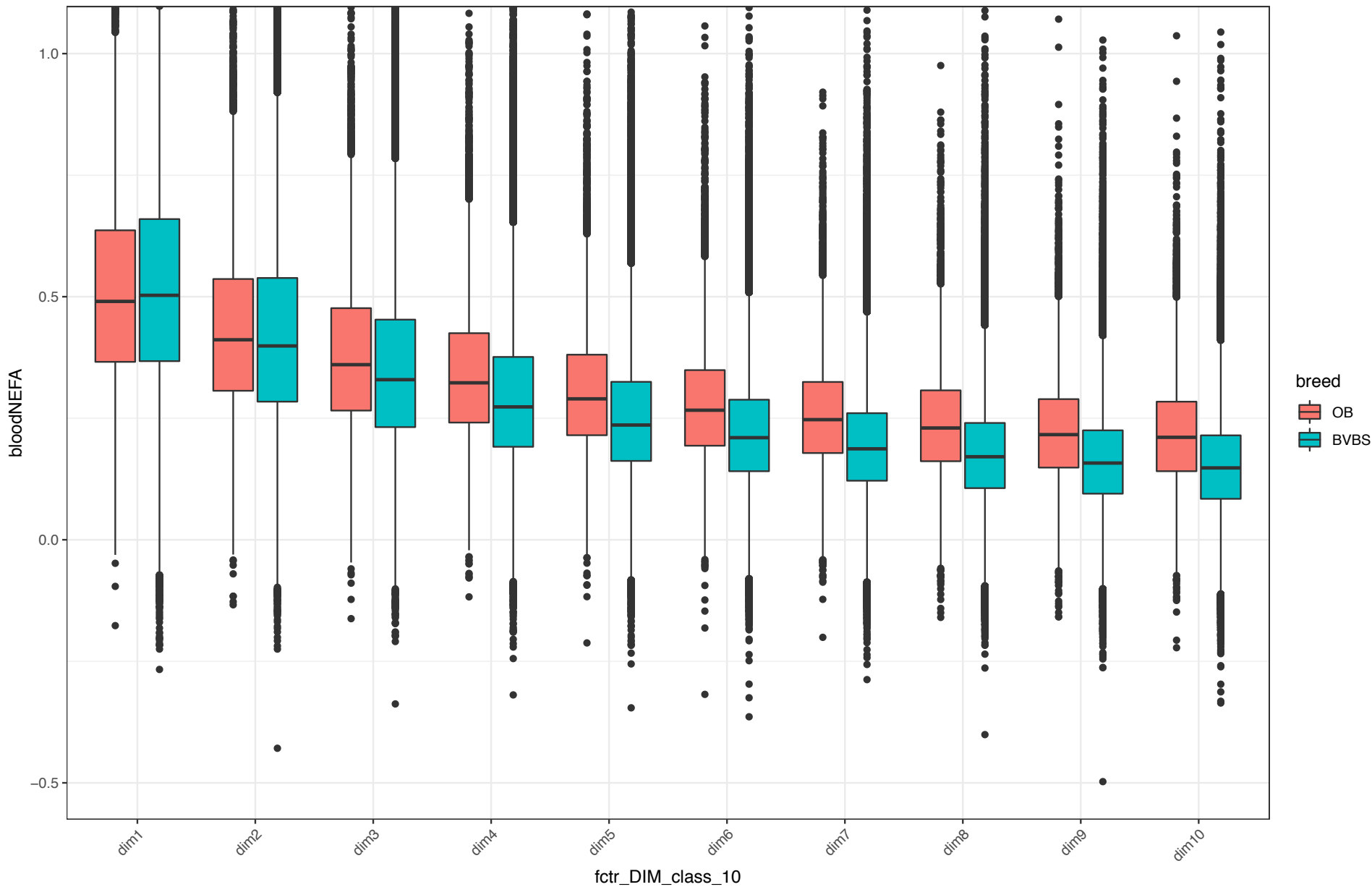
Conclusion

- Measurements are higher before than after cases of clinical ketosis

- Ketone body concentrations seem to be higher in the early-lactation and in dairy breeds (in the first 25 DIM only)

- The traits seem to be suitable for genetic evaluation

Next steps

- Definition of traits (highest or first measurement within DIM 5 and 45/60/??) for GE

- Estimation of variance components
  - multi-trait models

- Prediction of breeding values
  - Comparison with those from other countries

- (Validation of MIR-based predictions for BHB in blood, NEFA in blood, Aceton in milk)

Thank you