"KetoMIR2" - modelling of ketosis risk using vets diagnosis and MIR spectra for dairy cows in early lactation

Werner A. [1], Gollé-Leidreiter F.[1], Droessler K. [1], Auer F. J. [2], Mayerhofer M.[3], Köck A. [3], Egger-Danner C.[3], Dale L.M.[1]

[1]LKV - Baden-Wuerttemberg, Heinrich Baumann Str. 1-3, 70190, Stuttgart, Germany [2]LKV - Austria, Dresdner Straße 89/19, A-1200 Wien, Austria [3]ZuchtData EDV-Dienstleistungen GmbH, Dresdner Str. 89, 1200 Wien, Austria, Corresponding Author: ldale@lkvbw.de

| Ketosis - initial study

- the problem no.1 in early lactation
- ketosis risk modeling in the first 120 days of lactation is needed
  - based on diagnosis data from a health monitoring project (GMON)
  - MIR spectral data from the MLP milk analysis
    - 1 Test Sample/Animal/Month
- for milk production (up to 6 weeks) after calving ↑ energy is required:
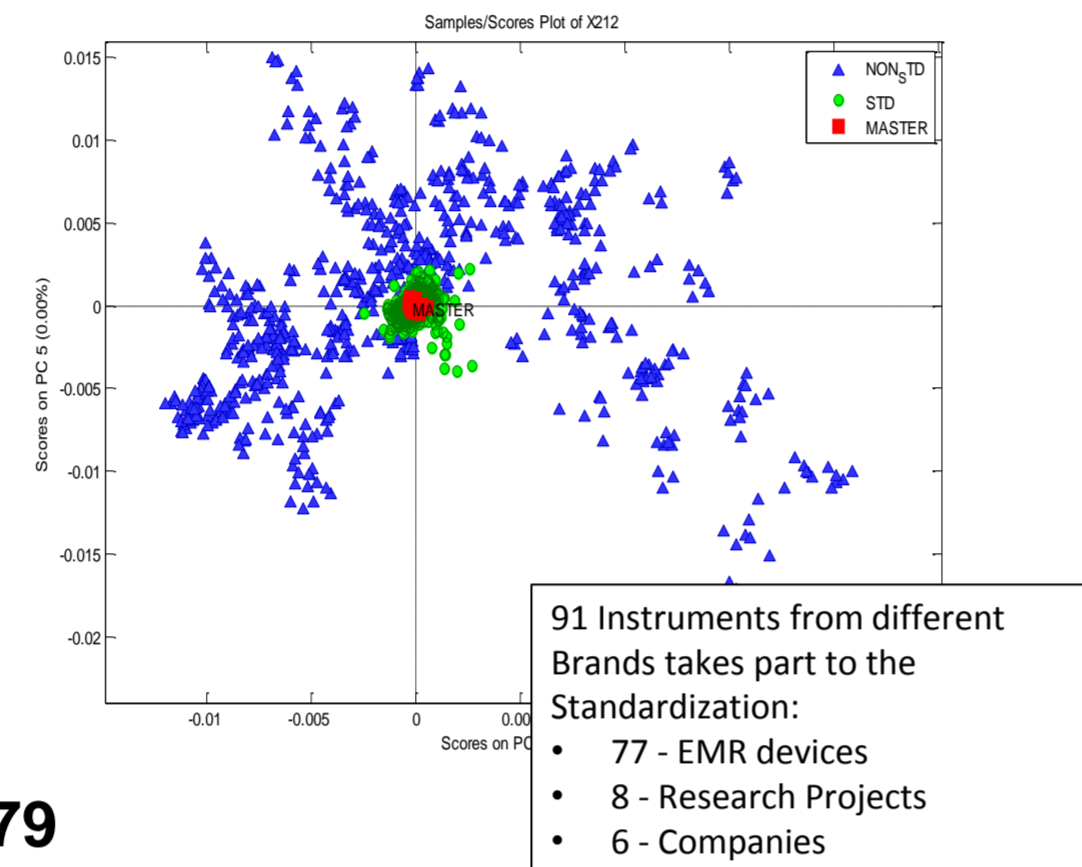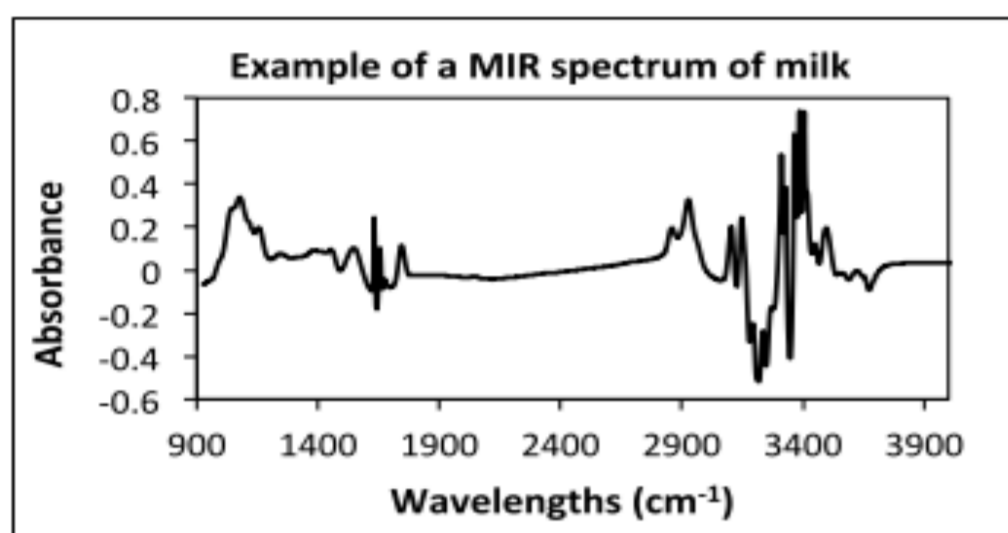
| Material and Methode

Fig.1: Typical Milk MIR- Absorption Spectrum (Source: OptiMIR)

- Period: **01.01.2012 – 30.09.2017**
- just Farms with Ketosis-Diagnosis: **10.079**
- MLP-Test days with Ketosis
  -14 ←→ +14 days between test day and diagnosis day: **1.638**
- MLP-Test days without Ketosis
  (Animals without diagnoses and health-related disposals): **808.858**
- Validation set: **18 representative farms**

91 Instruments from different Brands takes part to the Standardization:
- 77 - EMR devices
- 8 - Research Projects
- 6 - Companies

| Results

For each **Week in Milk** moderately and severely endangered percentages were chosen in the cumulation graph and the associated probability thresholds were identified.

Cumulation of Ketosis Probability

- Energy deficit => Body Fat Mobilization:
  long-chain fatty acids (FA) ↑
  short- and medium-chain FA ↓
- Overloading the liver => Ketone body formation
  Acetone, BHB, citrate↑
- Exposure to Metabolism => reduction in performance and possibilities for secondary diseases

- **Animal** related data - fix effects:
  - Breed, Parity, Milking Moment
  - Days in Milk, Milk Yield Groups
- KetoMIR I: uses MR and MIR components, in routine since 2015, to be improved
- KetoMIR II aims: **direct use of the MIR spectra and other ways of modeling**

Zeitraum	Calibration Set	Test Set
DIM 1-120	1.472/793.976	166/14.882
LKV-AT	736/510.864	39/1.822
LKV-BW	736/283.112	127/13.060

MIR-Spectral Data:
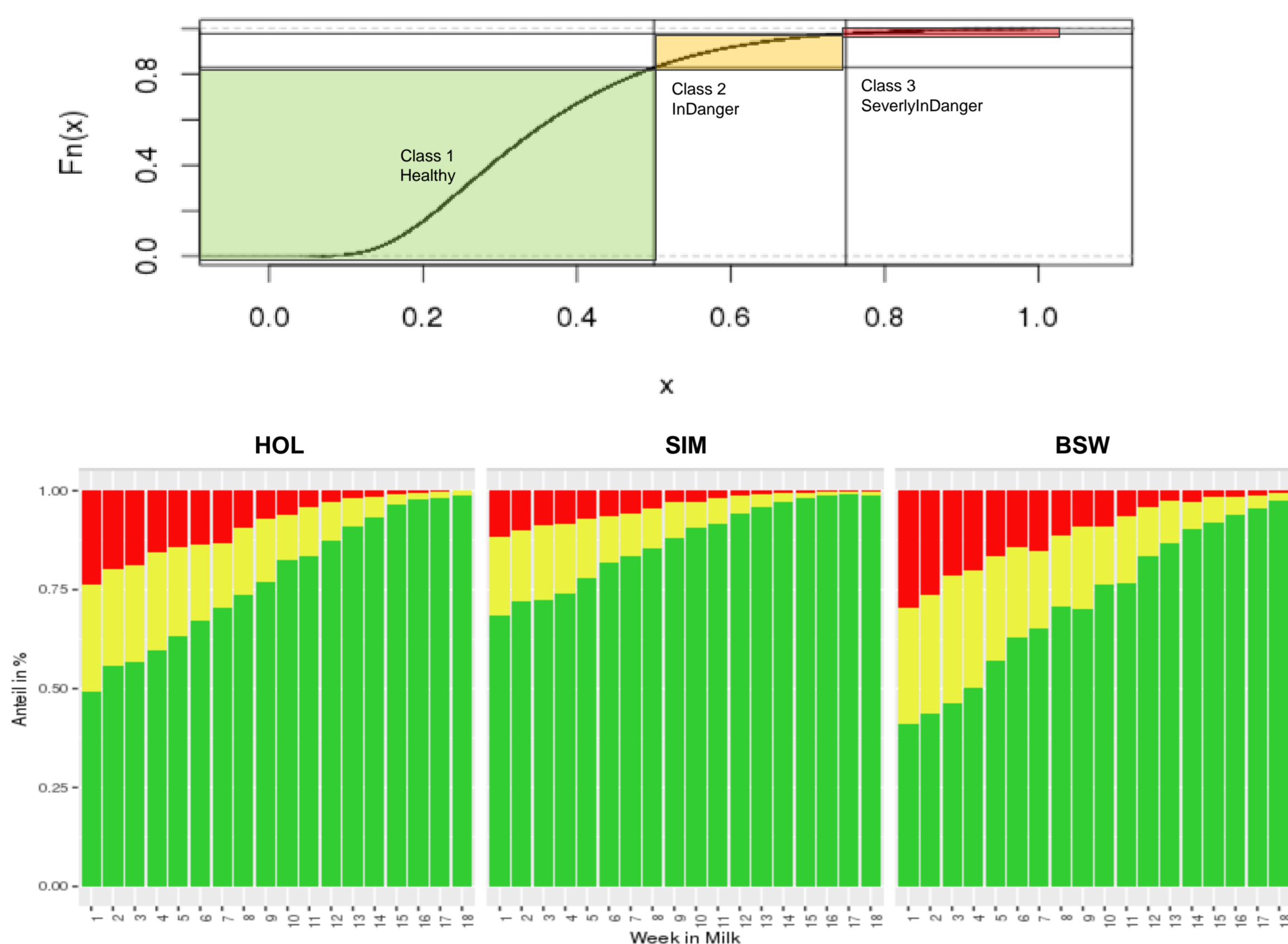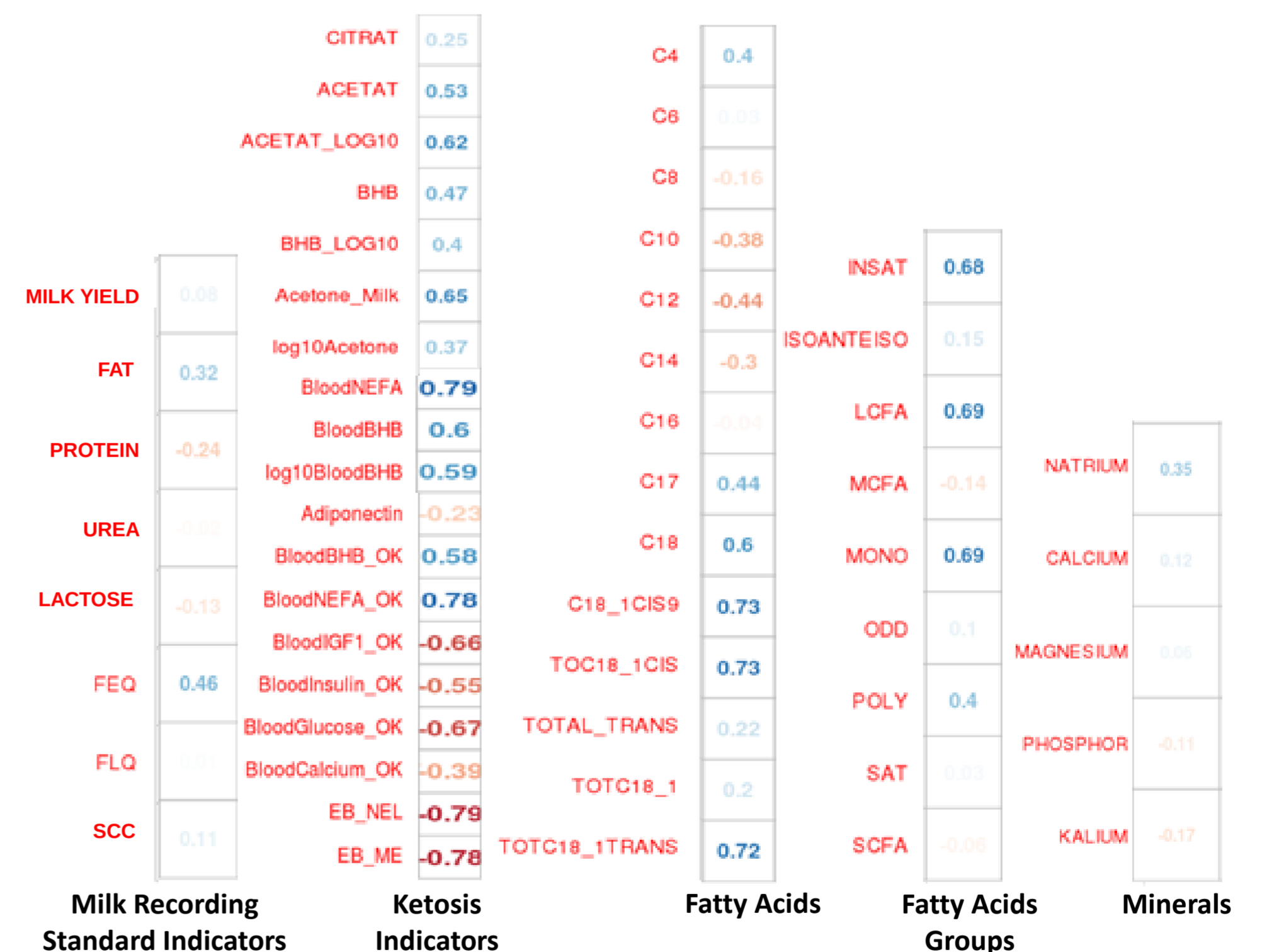Spectra + DIM Polynomial correction
CPPLS - canonical correlation analysis
GLMNET Regression

Model	Calibration Set		Test Set	
	Sensitivity	Specificity	Sensitivität	Specificity
Final Model	76,0%	84,0%	72,0%	83,0%
LKV-AT	76,0%	84,0%	72,0%	81,0%
LKV-BW	76,0%	85,0%	72,0%	84,0%
SIM	73,0%	86,0%	58,0%	88,0%
BSW	79,0%	79,0%	72,0%	81,0%
HOL	79,0%	82,0%	76,0%	83,0%

| Conclusion

- **KetoMIR** can well represent the ketosis risk
- The methods for KetoMIR: Legendre correction of DIM and CPPLS + GLMNET are acceptable
- The method can represent the ketosis risk well, but with a lower specificity:
  - **Calibration:**
    - Sensitivity -76,0%
    - Specificity - 84,0%
  - **Validation:**
    - Sensitivity - 72,0%
    - Specificity - 83,0%
- Recalibration and evaluation with other Ketosis Diagnosis data will be possible during the D4Dairy Project and evaluation in field is necessary