

# „MastiMIR“ - A mastitis early warning system based on MIR spectra

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## Mastitis Background

Mastitis is an inflammation of the mammary glands. It can be caused by more than 50 different organisms.

If a cow has mastitis problem not only:

- Milk yield [kg / day] ↓
- Somatic Cells [cells / ml] ↑

but it also react the milk main components

- Lactose [%] ↓
- Protein [%] ↑
- Fat / lactose ratio ↑

this also applies to the milk fine components:

- Sodium [mg / kg] ↑
- Lactoferrin [µg / ml] ↑
- BHB [mmol / l] ↑

## Material and Methods

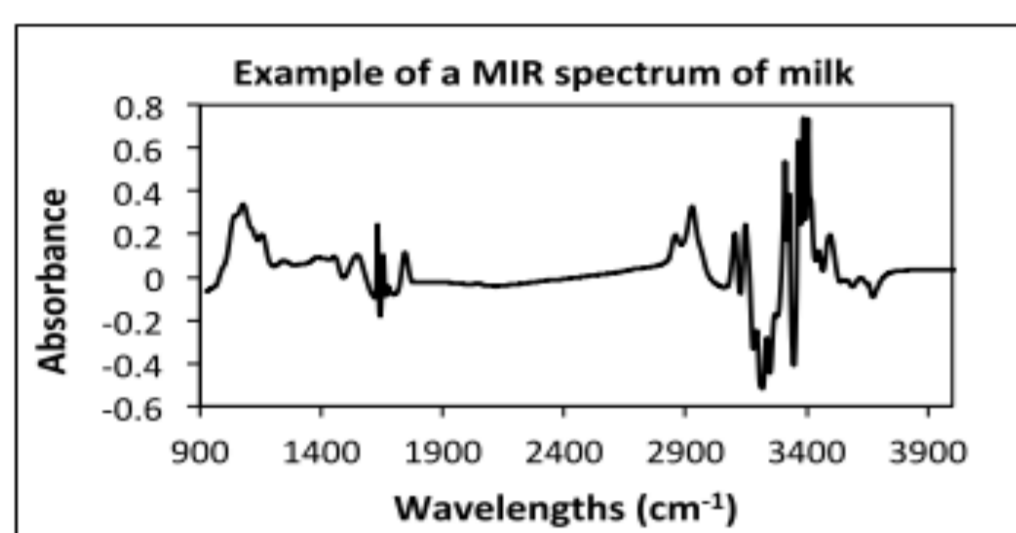
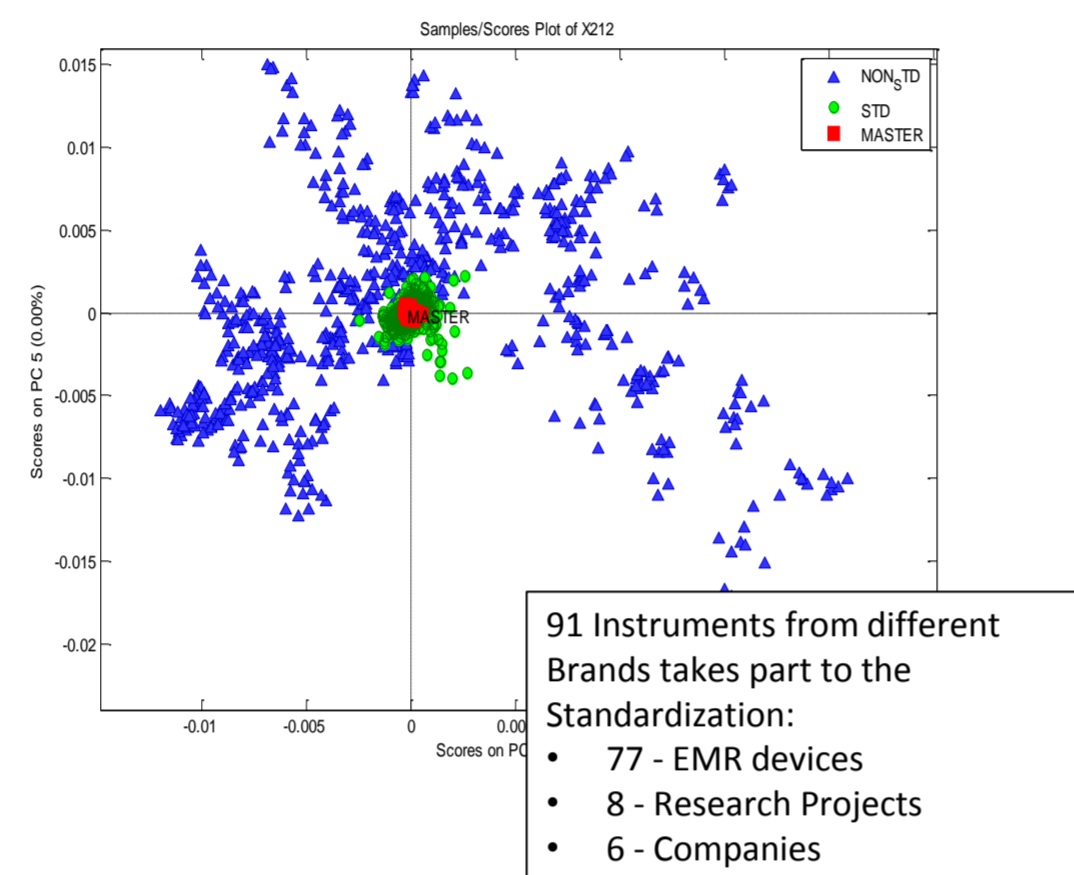


Fig.1: Typical Milk MIR-Absorption Spectrum (Source: OptiMIR)



### Mastitis- initial Study

- mastitis risk modeling in the whole lactation
  - based on diagnosis data from a health monitoring project (GMON)
- MIR spectral data from the milk recording analysis
  - 1 Test Sample/Animal/Month

### Animal related data - fix effects:

- Breed
- Parity
- Milking Moment
- Days in Milk
- Milk Yield Groups

### Milk Related Data:

- MIR-Spectral Data

### MIR-Spectral Data:

- Spectra + DIM Polynomial correction
- CPPLS - canonical correlation analysis
- GLMNET Regression

### Models:

- 1<sup>st</sup> Validation - based on a selection of spectral data using the Mahalanobis distance.
- 2<sup>nd</sup> Validation - based on a selection of different farms. Farms that are in validation, are not in the calibration!
- 3<sup>rd</sup> Validation - based on production data from a whole production year, data from 1st October 2017- 30 September 2018 in combination with diagnosis data

### Binominal Logit-GLMNET Model:

- **Healthy:**
  - no mastitis diagnosis
  - SCC less than 50,000
- **Not healthy:**
  - within 7 test days (TD) after the milk recording a mastitis diagnosis
  - no mastitis diagnosis before milk recording sampling
  - SCC over 400,000

### Validation Farms:

- 4 Holstein
- 2 Simmental
- 2 Brown Swiss

## Results

MastiMIR Model	Sensitivity	Specificity
Calibration	85.6%	90.3%
1 <sup>st</sup> Validation	74.9%	90.4%
2 <sup>nd</sup> Validation	75.6%	83.3%
3 <sup>rd</sup> Validation	63.9%	70.7%

### GMON Rind BW Data-bank:

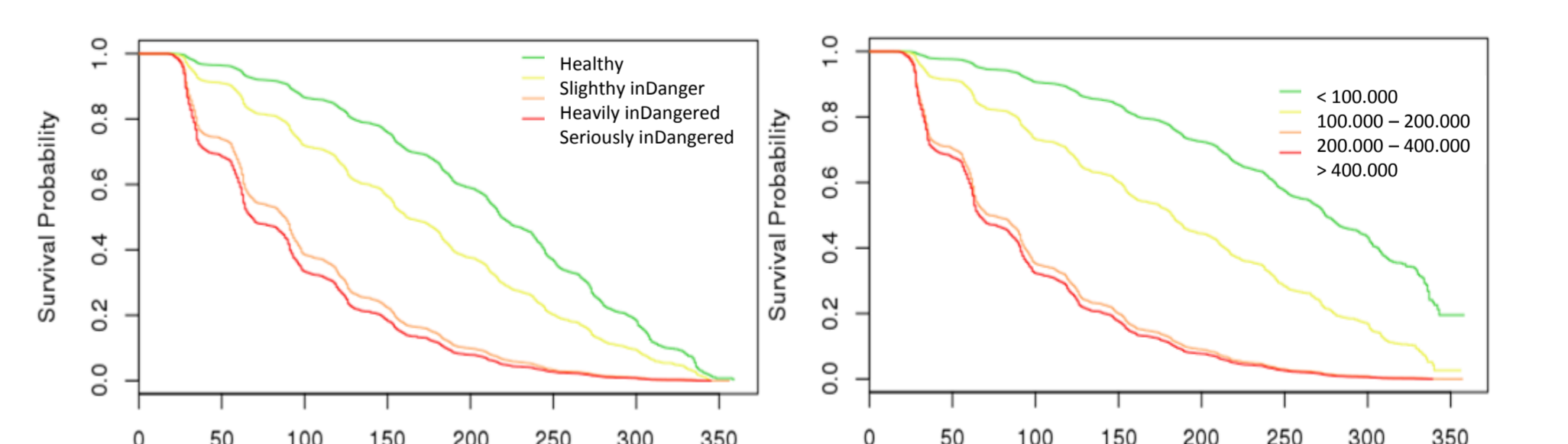
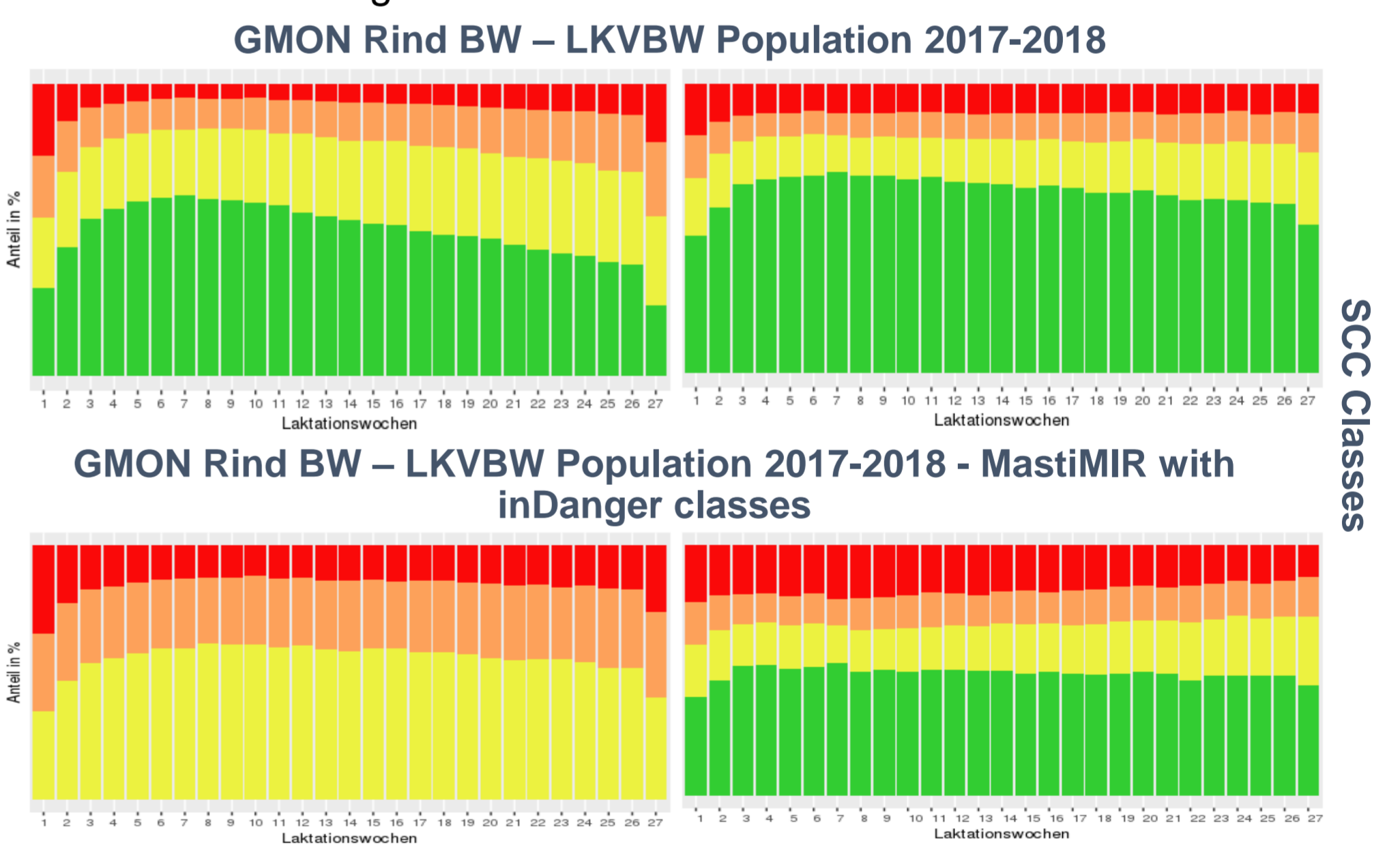
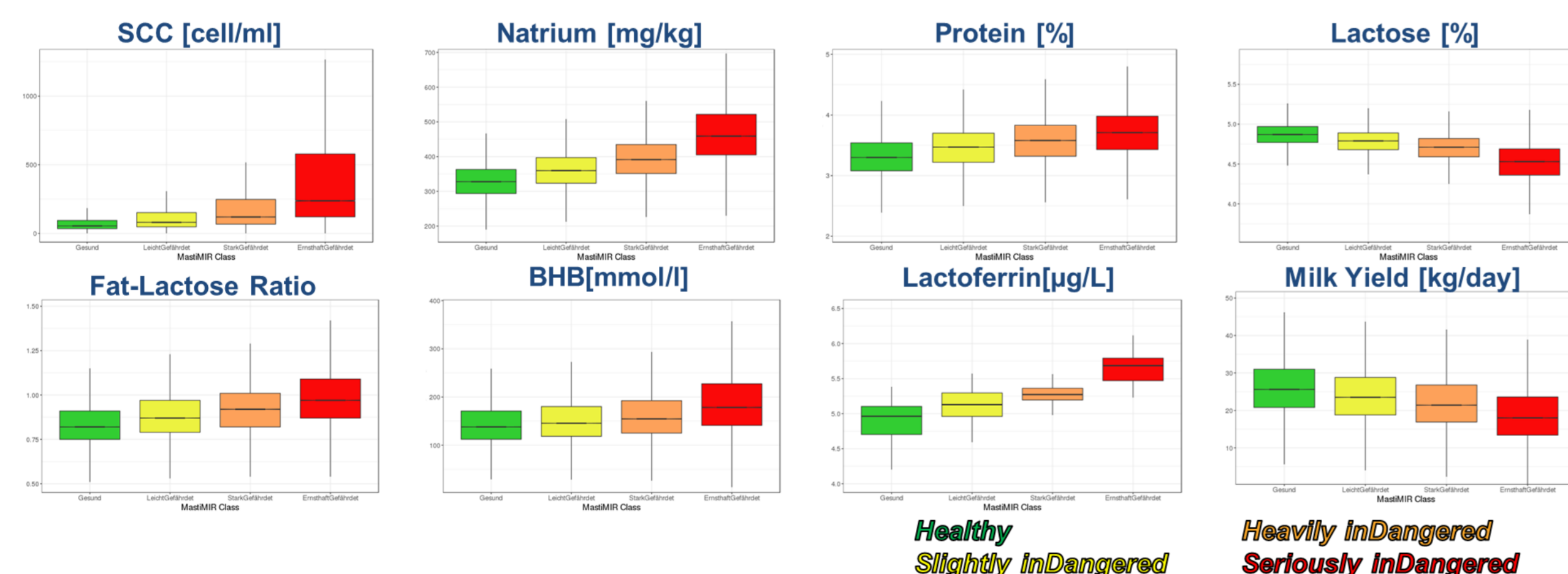
#### MastiMIR

Healthy	183.734
Slightly inDangered	133.240
Heavily inDangered	86.997
Seriously inDangered	59.405

#### SCC Class

< 100.000	270.590
100.000 – 200.000	93.102
200.000 – 400.000	51.537
> 400.000	48.008

### Classic Mastitis - Milk Indicators



The class limits were determined by using statistical methods such as cumulative probability and Cox event time analysis. The class size was negatively correlated with the mastitis class. It can be seen in the distributions of the MastiMIR and the SCC classes over the lactation week, that the mastitis class distribution has the shape of the lactation curve on both models.

## Conclusion

MastiMIR can well represent the mastitis risk.

Compared to the **SCC model**, the **MastiMIR model**

- shows an earlier occurrence
- of the "slightly inDangered" classification

MastiMIR can complement the **SCC model - classes**

An animal with higher SCC may still have other diseases.

Evaluation in the field is necessary

Local Baden Württemberg - Bentley-Spectral Data and - Diseases Diagnosis are an initial material study for different projects

## Acknowledge

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