Genetic parameters for ketosis and newly developed ketosis risk indicators based on MIR spectra

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Background

- Ketosis is the most frequent metabolic disease in dairy cows and has an unfavourable genetic correlation with milk yield

- Clinical ketosis based on veterinary diagnoses has a very low frequency - 0.60% Fleckvieh, 1.13% Brown Swiss, 1.13% Holstein

- **Efficient Cow**: 14% of cows with subclinical ketosis (based on milk ketotest >200µmol/l)

- Occurrence of ketosis is associated with a wide range of changes in the milk

  - acetone, BHB ↑

  - long-chain fatty acids ↑, short and medium chain fatty acid ↓

  - fat protein ratio ↑

  - …

Predicting ketosis risk from milk spectral data

- LKV Baden-Württemberg developed a tool named „KetoMIR" to detect ketosis

- Based on clinical ketosis diagnoses within the first 120 days after calving from health monitoring system

- Modelling of the ketosis risk based on milk mid-infrared (MIR) spectra from routine milk recording

KetoMIR 1 (Werner and Dale, 2017)

- Ketosis risk is calculated indirectly based on milk components (lactose%, protein%, fat protein ratio, acetate, C8, C17, SCFA, TOTC18:1TRANS, calcium) predicted from standardised milk MIR spectra.

- Sensitivity and Specificity:

	Calibration set	Validation set
Sensitivity	0.70	0.72
Specificity	0.86	0.84

- Routinely used by LKV Baden Württemberg and LKV Austria since 2015 and 2017, respectively.

- Used for herd management (e.g. feeding in the dry period). For early detection of ketosis in cows, the KetoMIR result is often too late (often one month after calving)

KetoMIR 2 (Dale et al., 2018)

- Ketosis risk is calculated directly from the milk MIR spectra by using GLMNET modelling approaches.

- Sensitivity and Specificity:

	Calibration set	Validation set
Sensitivity	**0.76**	**0.72**
Specificity	**0.84**	**0.83**

Objective

The specific objective was to estimate genetic parameters (heritabilities and genetic correlations) for clinical ketosis and these newly developed ketosis risk indicators in Austrian dairy cattle

Data

- Traits
  - Clinical ketosis
    - Veterinary diagnoses within the first 120 days after calving
  - KetoMIR 1 and 2
    - First test-day result after calving (5-30 DIM)
    - Continuous variable (numeric range between 0 and 1)
    - Class variable (3 ketosis risk classes): not in danger – moderately endangered - severely endangered

- Number of records
  - 71,536 for Fleckvieh
  - 13,591 for Brown Swiss
  - 14,543 for Holstein

Model

- Sire model

- Fixed effects: herd-year of calving, year-month of calving, lactation and days in milk (only for KetoMIR 1 and KetoMIR 2)

- Random effects: sire of cow, permanent environmental effect

Frequencies

	Fleckvieh	Brown Swiss	Holstein
Clinical ketosis	0.6 %	1.1%	1.1 %
KetoMIR 1_not in danger	83.7 %	62.4 %	66.4 %
KetoMIR 1_moderately endangered	14.4 %	30.6 %	27.0 %
KetoMIR 1_severely endangered	1.9%	7.0 %	6.6 %
KetoMIR 2_not in danger	76.0 %	45.9 %	43.7 %
KetoMIR 2_moderately endangered	16.3%	32.3%	32.4 %
KetoMIR 2_severely endangered	7.7%	21.8 %	23.9 %

Heritabilities

	Fleckvieh	Brown Swiss	Holstein
Clinical ketosis	0.003	0.007	0.008
KetoMIR 1_continuous	0.28	0.23	0.15
KetoMIR 1_classes[1]	0.14	0.14	-
KetoMIR 2_continuous	0.20	0.17	0.10
KetoMIR 2_classes[1]	0.10	0.14	-

[1]3 classes: not in danger – moderately endangered - severely endangered

Genetic correlations
Clinical ketosis and KetoMIR

	Fleckvieh	Brown Swiss	Holstein
KetoMIR 1_continuous	0.65 (0.23)	0.42 (0.41)	0.53 (0.41)
KetoMIR 1_classes[1]	0.74 (0.22)	0.53 (0.38)	-
KetoMIR 2_continuous	0.46 (0.23)	0.51 (0.40)	0.71 (0.48)
KetoMIR 2_classes[1]	0.73 (0.22)	0.80 (0.32)	-

[1]3 classes: not in danger – moderately endangered - severely endangered

Genetic correlations between KetoMIR and fat-protein-ratio
0.43 – 0.57

Conclusions

- First results for KetoMIR look promising

  - Heritabilities 0.10 – 0.28

  - Genetic correlations with clinical ketosis 0.42 – 0.80 (however results are associated with high standard errors → very low frequency of clincial ketosis)

- Additional evaluation with data on clinical and subclinical ketosis is needed

Acknowledgement

Many thanks to colleagues from partners of project 2.2 "Disease Detection with Milk Spectral Data - Use of milk mid-infrared spectroscopy to predict the health status of dairy cows" within D4Dairy

Thank you for your attention!

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