

# First results in the use of milk MIR spectra in the detection of lameness in Austrian dairy cows

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# Prevalence

- Varies greatly across farms (Austria and abroad)
  - On average: 20 - 40%
  - Certain farms: > 75%
- Many environmental factors
  - Pasture
  - Tie- or free-stall
  - ...

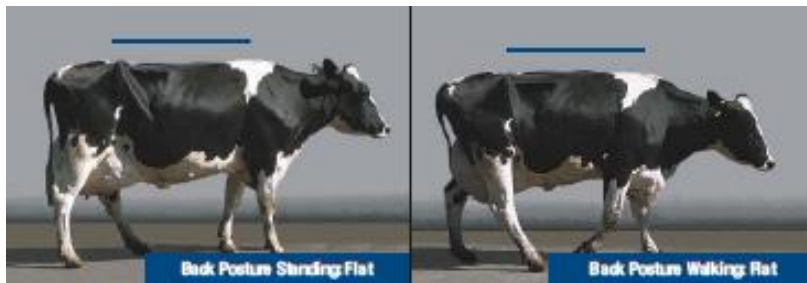
# Importance of lameness



# Locomotion scoring

- Assessment of lameness
  - Many systems
  - Based on levels
  - Differences in:
    - Gait
    - Back arch
- For this research  
⇒ Sprecher *et al.*, 1997
  - Trained staff!

1



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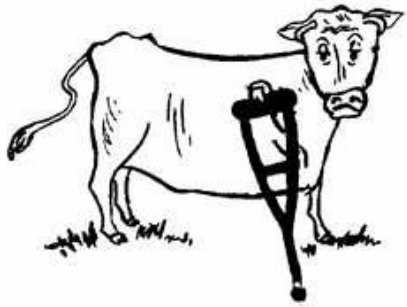


# Objective

Assess the possibility of using milk composition to detect and predict potential lameness.

# Lameness, metabolic disorders & milk composition

## Theory

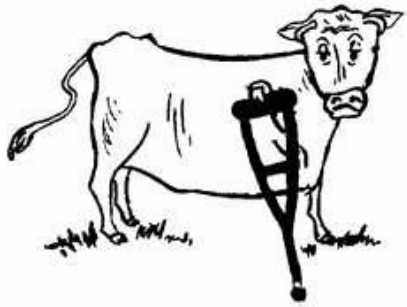


### METABOLIC DISORDERS

- Body fat mobilization – Ketosis
- Sub Acute Ruminant Acidosis



# Lameness, metabolic disorders & milk composition Theory



## METABOLIC DISORDERS

- **Body fat mobilization – Ketosis**
- Sub Acute Ruminal Acidosis

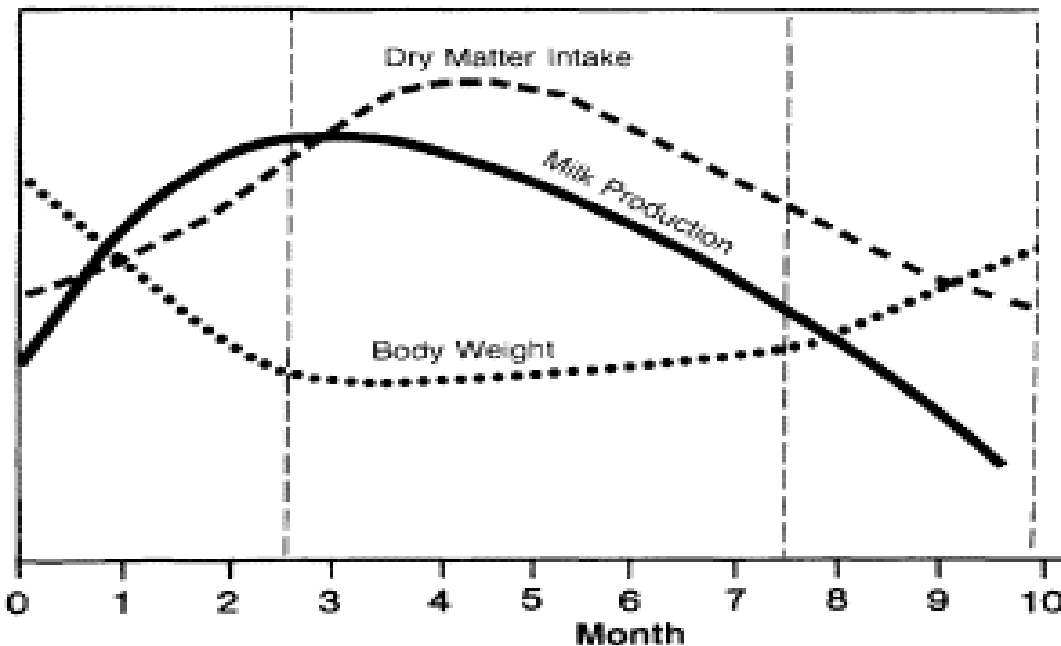


# Body fat mobilization - Ketosis



1. F:P ratio $\uparrow$ , NEFA, C18:1cis9
2. Citrate
3. BHB, acetone

1. Smaller feed intake
2. F:P ratio $\uparrow$ , NEFA, C18:1cis9
3. Citrate
4. BHB, acetone

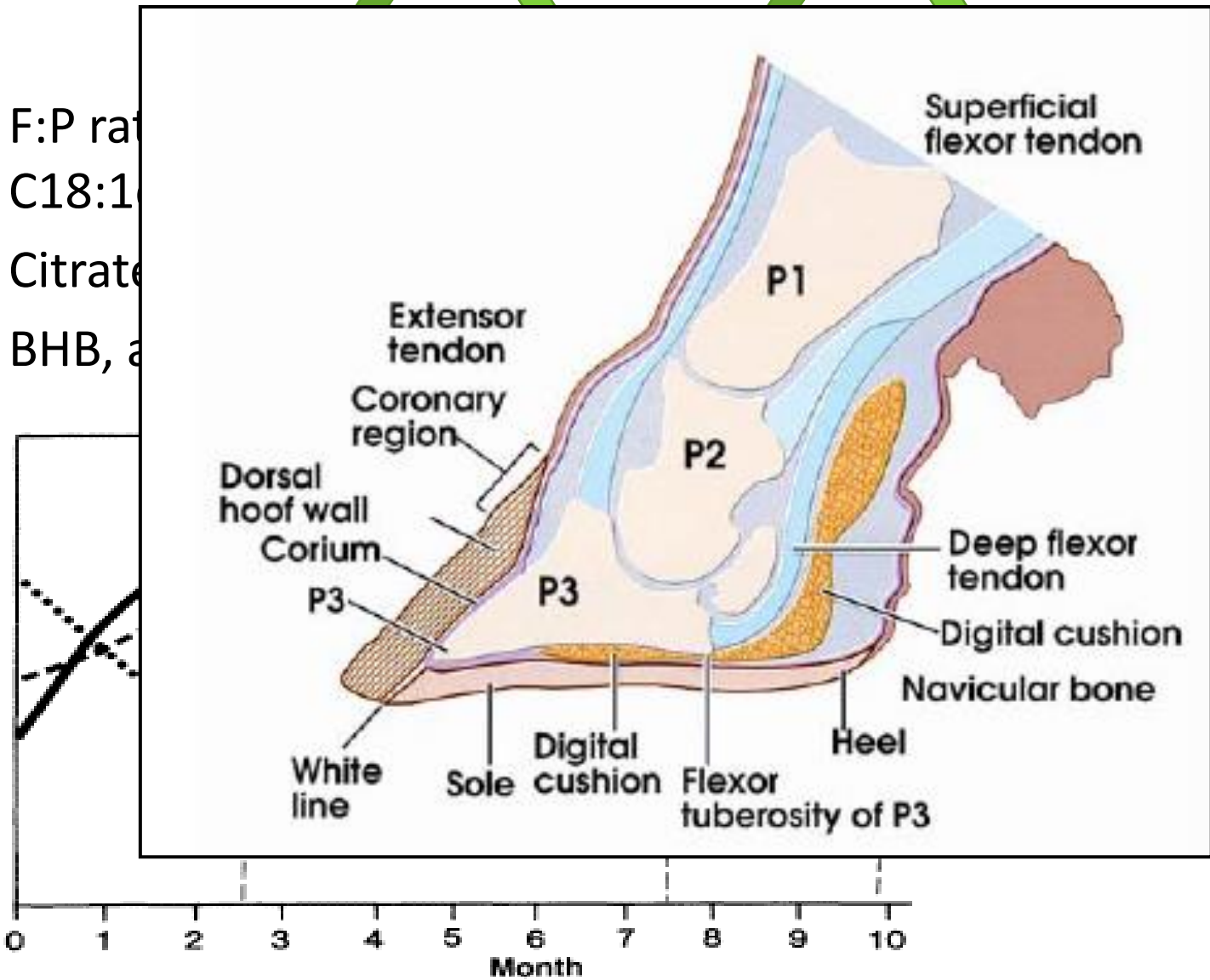




# Body fat mobilization - Ketosis

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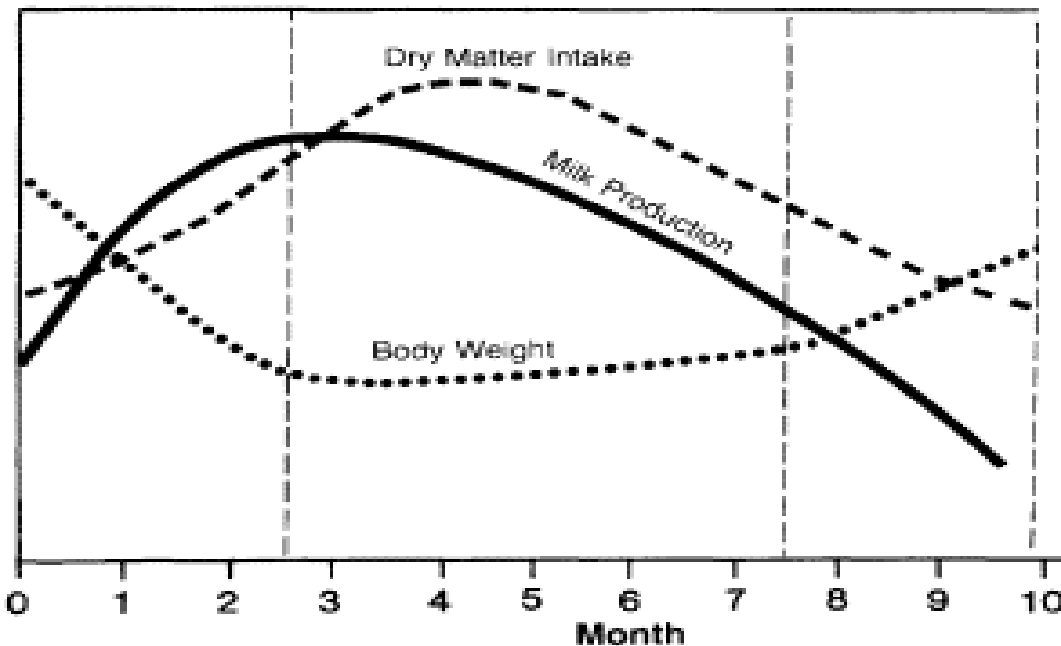


# Body fat mobilization - Ketosis



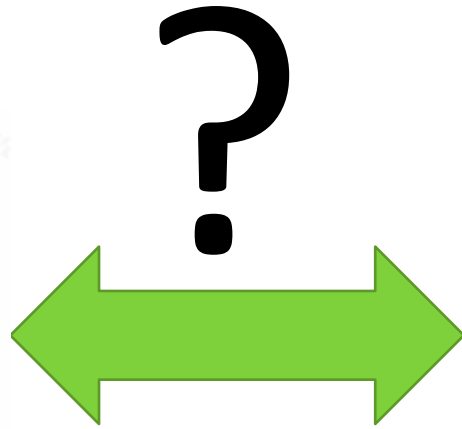
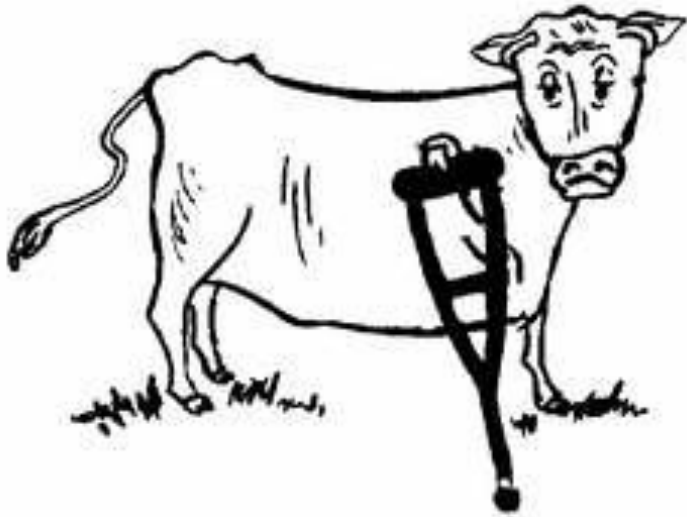
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1. Smaller feed intake
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# Lameness & milk composition

## Practice



# Mid-infrared (MIR) spectroscopy

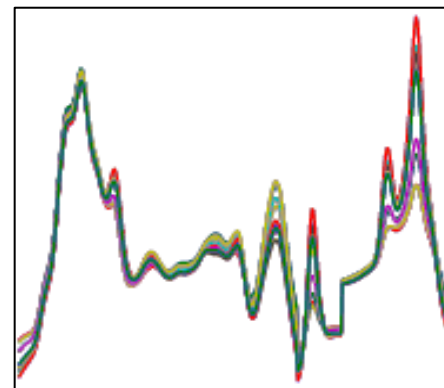
Milk samples



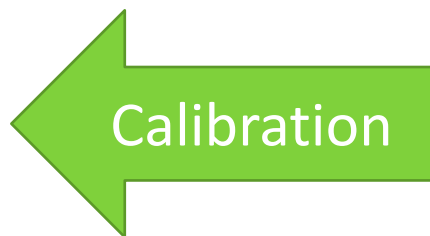
MIR analysis



MIR spectra



Calibration



Reference values

- Prediction
  - **Major milk components**
    - Fat
    - Protein
    - Urea
    - Lactose

# MIR spectroscopy

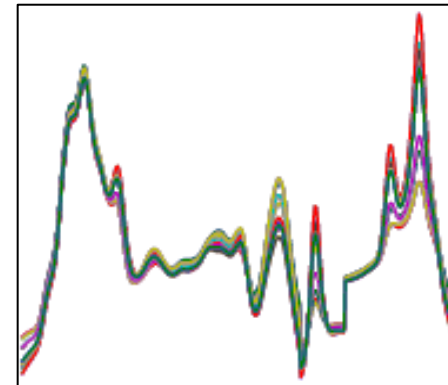
Milk samples



MIR analysis



MIR spectra



- Prediction

- Major milk components

- **Novel components**

- BHB, Acetone
- Citrate
- Fatty acids

Calibration



Reference values

# MIR spectroscopy

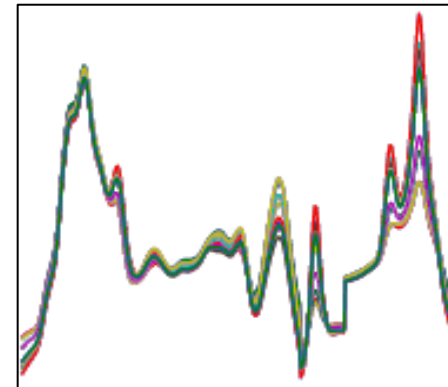
Milk samples



MIR analysis



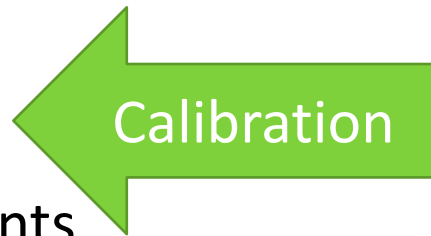
MIR spectra



- Prediction

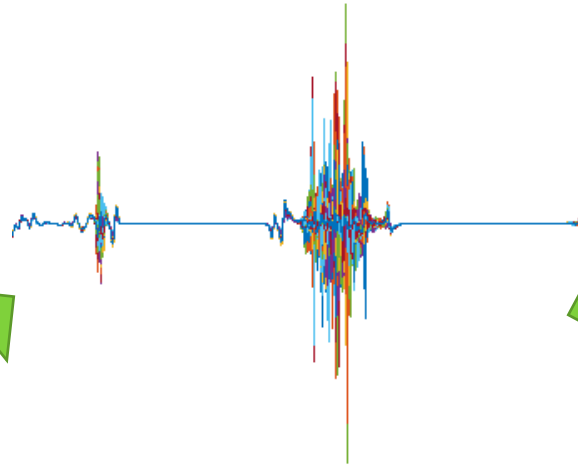
- Major milk components
- Novel components
- **Lameness**

Calibration



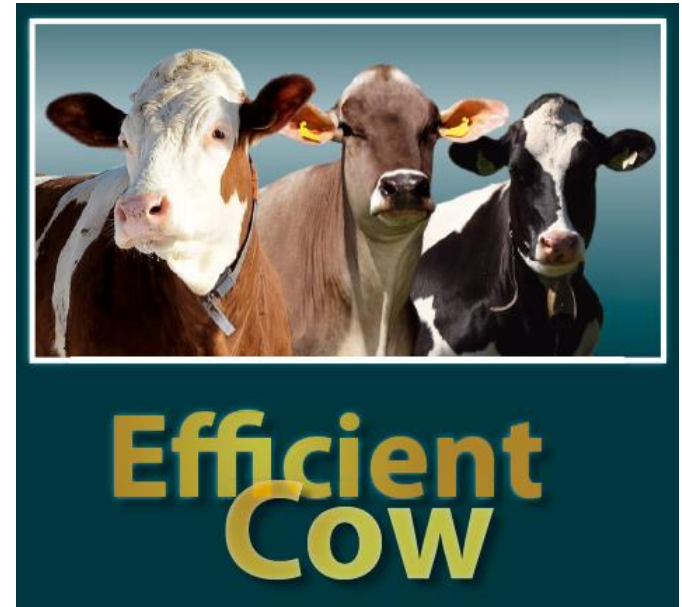
Reference values

# Need of relevant data



# “Efficient Cow” data

- July to December 2014
- FOSS instruments (FTIR-MIR)
- 9324 records (3895 cows, 122 farms)
- Classification
  - Sound = locomotion scores 1, 2
  - Lamé = locomotion scores 3, 4, 5
  - 8% of lame cows



RINDERZUCHT AUSTRIA (ZAR)



# Calibrations using PLS-DA

- Calibration
  - 2/3 of records
- Validation
  - 1/3 of records
- Sensitivity = true positives
  - Truly lame
  - Locomotion scores: 3, 4, 5
- Specificity = true negatives
  - Truly sound
  - Locomotion scores: 1, 2

# Results of calibrations

- All data
  - 11 latent variables (LV)

ALL*	Sensitivity (%) (lame)	Specificity (%) (sound)
Calibration	63	63
Validation	60	62

- Subsets

# Results of calibrations

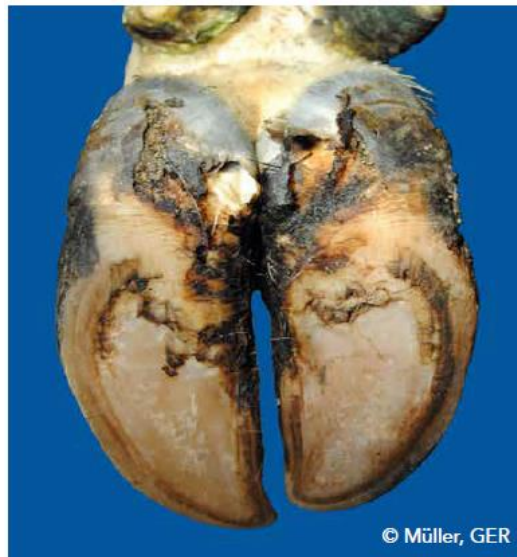
- Breed (% of lame records, locomotion score 3, 4, 5)
  - Brown Swiss: 5.6%, Simmental: 6.5%, Holstein: 9.5%
  - 11 LV

ALL subset		Sensitivity (%) (lame)	Specificity (%) (sound)
Simmental	Calibration	(71) +8	(62) -1
	Validation	(62) +2	(59) -3
Brown Swiss	Calibration	(68) -5	(70) +7
	Validation	(67) +7	(63) +1
Holstein	Calibration	(68) +5	(70) +7
	Validation	(43) -17	(71) +9

# Results of calibrations

- Best result
  - Very specific lesion: Heel horn erosion

ALL subset	Sensitivity (%) (lame)	Specificity (%) (sound)
Calibration	(88) +15	(93) +20
Validation	(85) +15	(91) +19

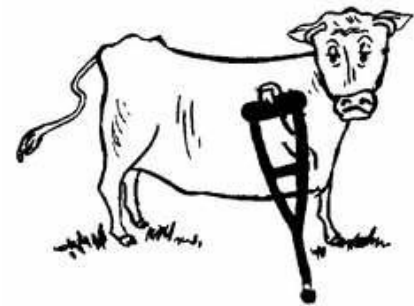


# Conclusions

- Interesting results of calibration
  - More research needed to confirm results
- Great variability – complex trait
  - Causes: potential opposite effects on milk composition
  - Breeds: difference predisposition to lameness
  - Parities: reflecting development and age differences
- More data needed => cover variability

# Perspectives and ideas for future research

- Classical + Innovative data
  - Dairy cow performance
  - MIR, vet, hoof, sensor data
- Definition of novel traits
  - Lameness
  - Metabolic disorders



# Perspectives and ideas for future research

- Genetic studies
  - Genetic variabilities
  - Correlations with other traits
- Develop genomic evaluations
- Collaboration with breeding association (AWÉ)
  - Wellness index => genomic evaluation services



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