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Detection of mastitis during milking

current solutions and prospective ideas

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Agenda

1. Introduction
2. Mastitis detection - current solutions
 - State of udder health in AMS farms
 - Performance of basic commercial sensors
 - Performance of SCC sensors
3. Prospective ideas
 - Mastitis indicators and technical solutions
 - Near-infrared spectroscopy
 - Real-time PCR
 - IR thermography
4. Take home questions

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Introduction

1. Automatic detection of abnormal milk is mandatory in AMS
[Regulation (EC) No. 853/2004]
2. Frequency of subclinical mastitis > Frequency of clinical cases
 - Reduced milk yield & increased risk for infection of other cows
 - Susceptibility for other diseases
 - Milk composition, milk quality




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Mastitis detection – current solutions

State of udder health in AMS farms

Study on udder health in 12 AMS farms in Northern Germany (Brandt et al., 2012)



> 3 times per farm, weekly intervals, samples of all lactating cows

Sampling routine:

- I. Foremilk inspection;
- II. Samples for cyto-bacteriology

Brandt, M., A. Haeussermann, K. Knappstein, E. Hartung (2012): State of udder health in farms with automatic milking systems in Northern Germany. In (Brandt, M.): Ph.D. thesis, Institute of Agricultural Engineering, CAU Kiel

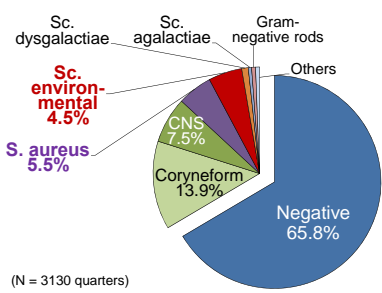
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Mastitis detection – current solutions

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(N = 3130 quarters)

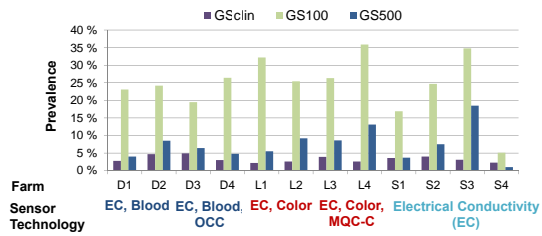
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Mastitis detection – current solutions

State of udder health in AMS farms



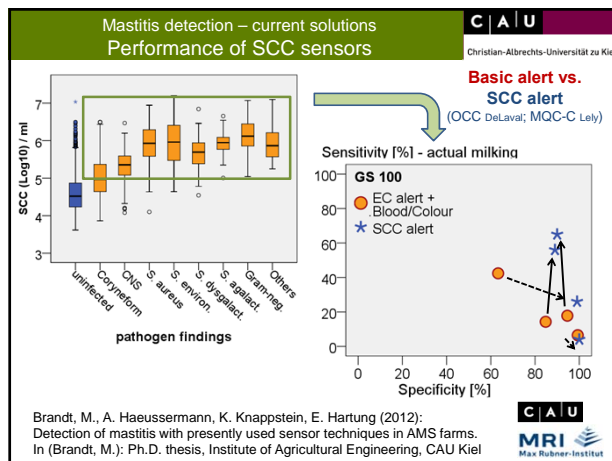
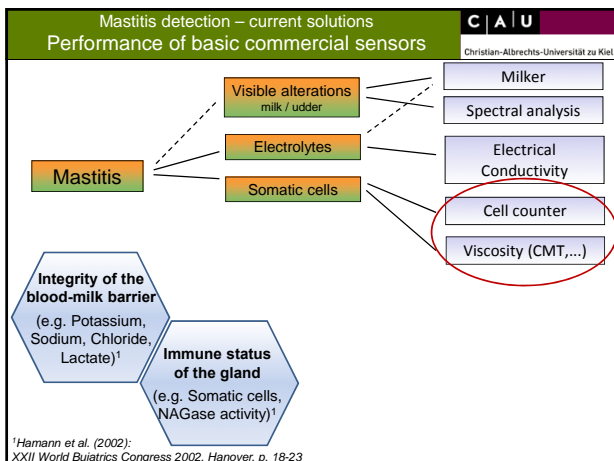
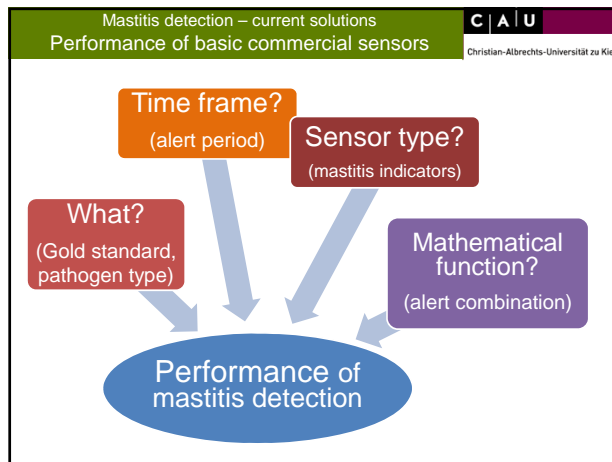
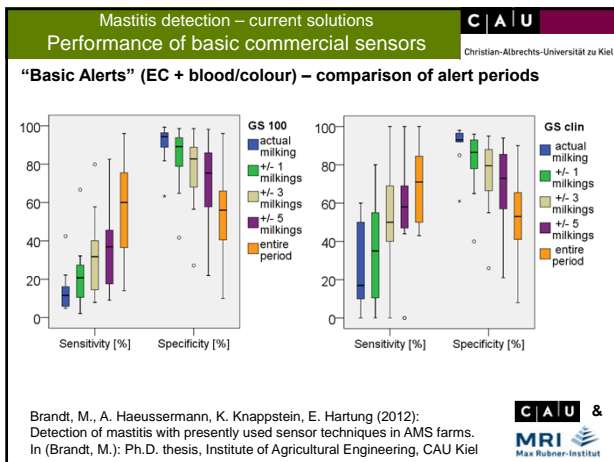
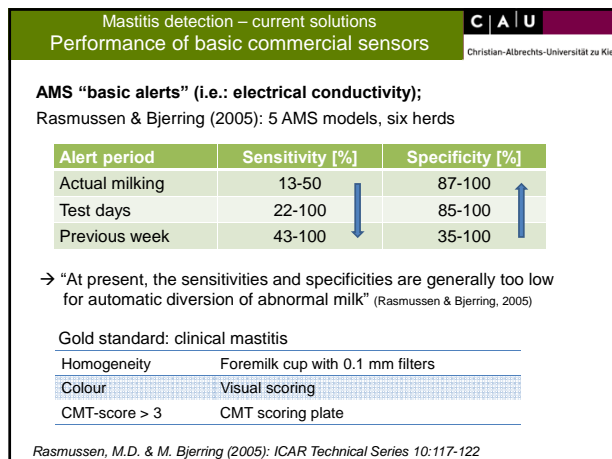
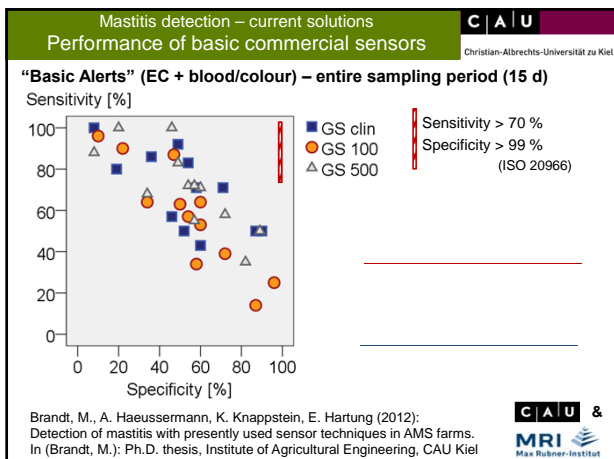
Farm	Sensor Technology	GS _{clin}	GS ₁₀₀	GS ₅₀₀
D1	EC, Blood	~5%	~20%	~5%
D2	EC, Blood	~5%	~25%	~5%
D3	OCC	~5%	~15%	~5%
D4	OCC	~5%	~25%	~5%
L1	EC, Color	~5%	~30%	~5%
L2	EC, Color	~5%	~25%	~5%
L3	EC, Color	~5%	~25%	~5%
L4	MQC-C	~5%	~35%	~5%
S1	EC	~5%	~15%	~5%
S2	EC	~5%	~25%	~5%
S3	EC	~5%	~35%	~5%
S4	EC	~5%	~15%	~20%

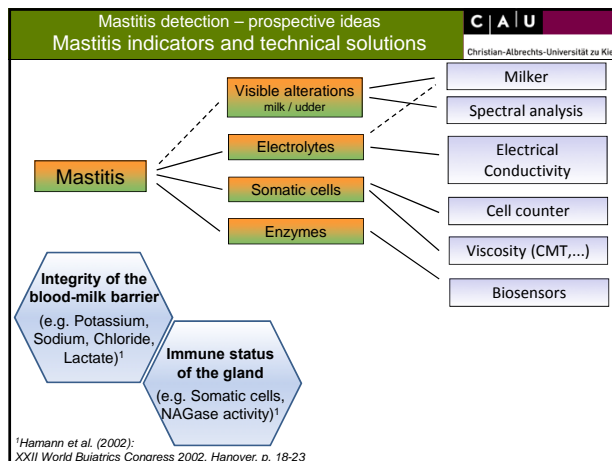
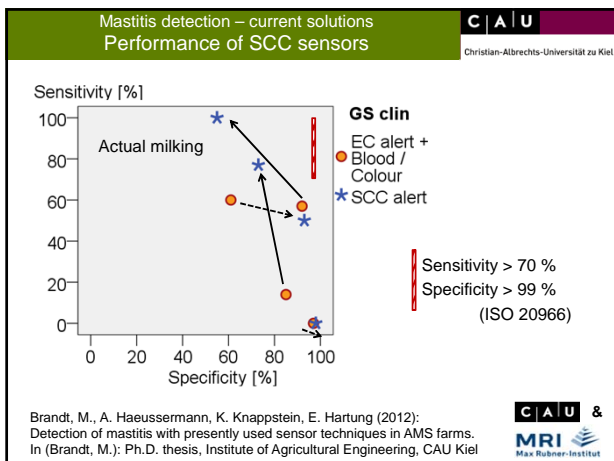
Gold Standards

GS _{clin}	Clinical mastitis
GS ₁₀₀	SCC > 100.000 cells/ml & mastitis pathogens
GS ₅₀₀	SCC > 500.000 cells/ml & major mastitis pathogens

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Mastitis detection – prospective ideas

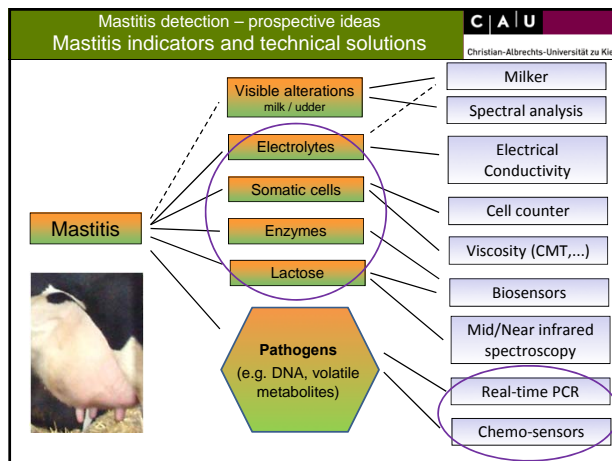
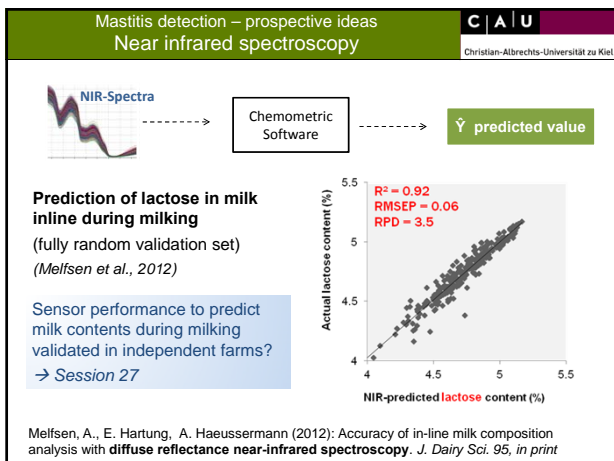
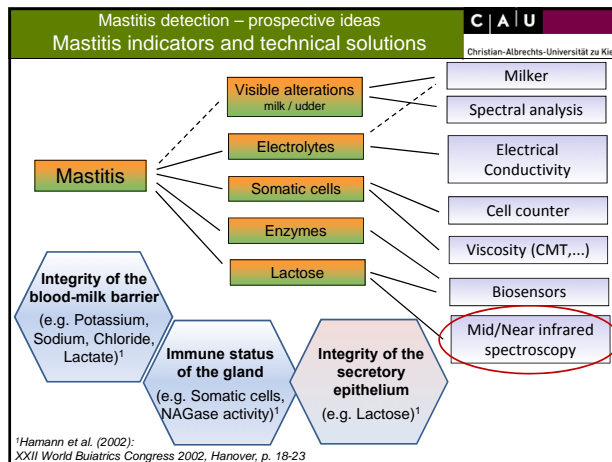
Indicators in milk

Diagnostic test criteria of different milk constituents to identify newly infected udder quarters (Krömker et al., 2001)

Parameter	Milk fraction	Parameter threshold	Sensitivity (%)	Specificity (%)	Probability of misclassification (%)
NAGase [log 10]	FM	0.42 nmol / min / ml	71,7	79.8	22.3
Lactose	CM	4.7 %	60.8	80.6	26.1
Lactate	CM	80 nmol/l	43.3	94.7	22.9
EC	FM	6.5 mS/cm	35.6	95.1	19.9
Chloride	CM	35 mmol/l	33.5	94.7	26.3

Gold standard: cyto-bacteriological findings (DVG, 2002)

Krömker et al., 2001; In: Hamann et al.: Milk constituents as tools for mastitis detection. Satellite Symposium „Novel Aspects of Mastitis Therapy“, XXII World Buiatrics Congress 2002, Hanover



Mastitis detection – prospective ideas
Real-time PCR

1. Highly sensitive for detecting bacteria in **quarter milk samples**
➢ Infection or contamination?

2. **Bulk milk**
➢ Very specific for classification of herd status in respect of specific contagious pathogens (Syring et al., 2012)
➢ No precise estimation of mastitis prevalence in the herd (Spohr & Breitenwieser, 2012)

3. **Milk meter samples**
➢ Identification of *S. aureus*, *esculine*-positive and -negative streptococci (Friendship et al., 2010; Spohr & Breitenwieser, 2012)
➢ High risk for false positive results in respect of environmental mastitis pathogens (Spohr & Breitenwieser, 2012)

¹Syring, C. et al. (2012); J. Dairy Sci. 95:3674-3682; ²Friendship, C. et al. (2010); NMC Ann. M. Proc. 226-227; ³Spohr, M. & Breitenwieser (2012); Prakt. Tierarzt 93(4):342-350

Mastitis detection – prospective ideas
Real-time PCR

Mastitis detection – prospective ideas
Mastitis indicators and technical solutions

Mastitis detection – prospective ideas
IR thermography

1. Initial investigations (Barth, 2000):

- Highly sensitive infrared-thermo camera
- Indication of quarter **SCC > 100.000/ml** and of **clinical mastitis**, but:
- Susceptible to location of measuring point and perspective (medial, lateral or caudal)

2. Profound experiments (Hovinen et al., 2008):

- *E. coli* mastitis experimentally induced on left forequarters
- Detection of **clinical mastitis**: udder & rectal surface temperature 4 h post challenge
- Local signs on udder, changes in milk appearance: already 2 h post challenge

➔ **Clinical mastitis influenced the relation of medial:lateral teat surface temperature (Barth, 2000; Hovinen et al., 2008)**

Barth, K. (2000); Milk Science International 55 (11):607-609
Hovinen, M. et al. (2008); J. Dairy Sci. 91:4592-4598

Mastitis detection – prospective ideas
IR thermography

3. Field experiments

N	Threshold	Diagnostics	Conditioning	Authors
62 Brown Swiss dairy cows	SCC > 400,000/ml; SCC > 200,000/ml no clinical sympt.	SN: 96%; SP 94% SN: 84%; SP 100% Cut-off: 34,7 C	Preselected; temperature conditioned	Polat et al. 2010
552 HF dairy cows	SCC > 100,000/ml & bacteria findings	SN: 30%; SP: 70%	-	Franze et al. 2012

Polat, B. et al. (2010); J. Dairy Sci. 93:3525-3532
Franze, U. et al. (2012); Züchtungskunde 84:158-170

Mastitis detection – prospective ideas
Take home questions

- Development and test of new mastitis detection methods and sensors is still an important task
 - Mathematical functions ?
 - Combination of indicators and sensor techniques ?
 - Need to be more specific on kind of pathogens ?
- On-farm or in-line utilisation (robust, cheap, easy-to-handle, and rapid) is not applicable for all techniques
➔ best solutions for herd management ?
- Best "Gold Standard" for prevention of mastitis ?
➔ abnormal milk vs. subclinical mastitis

Thanks to...

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- Monika Brandt and Andreas Melfsen who sampled and evaluated a good part of the data on udder health and/or sensors used in this presentation
- Karin Knappstein and the Max-Rubner-Institute Kiel for scientific and technical support in our study on udder health
- The staff and farmers in the private dairy farms, included in the studies, and the research stations in Karkendamm, Futterkamp and Schädtebek for the possibility to sample milk and data records
- The AMS companies for support, e.g. with herd management programs for data evaluation

Thank you for your attention!

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