Potential of fine milk composition for cow udder health management

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Background

Mastitis is the most frequent and costly disease in dairy cattle

Multiple forms: from clinical to sub-clinical cases, from acute mastitis to chronic mastitis, recovery or not

Mastitis affects the milk production of the cow as well as the milk composition and quality

SCC is the most used indicator in milk

Objectives

Udder health management at individual and herd level

→ early detection of mastitis

→ identification of cows suffering from chronic infections

1. **Define the different mastitis cases**
2. **Describe changes in milk composition which occur during clinical mastitis**
3. **Investigate the potential of milk composition to provide**
   - **→ early indicator of mastitis**
   - **→ early indicators of recovery**

Data and editing

Clinical cases of mastitis are voluntary recorded by farmers in commercial farms from the Walloon Region of Belgium involved in the DHI program

- ✓ **Recording period of the herd ≥ 180d**
- ✓ **No. of cows with clinical mastitis cases / total no. of cows within the herd over the period > 5%**
- ✓ **Only lactations that started after the beginning of the recording period**
- ✓ **Test-day from the recording period and from the 305 first days of lactation**

44,644 test-day from 7,878 lactations

4,960 cows from 49 herds

➔ 23% of the lactations experienced at least one clinical mastitis event

Definitions of mastitis trait

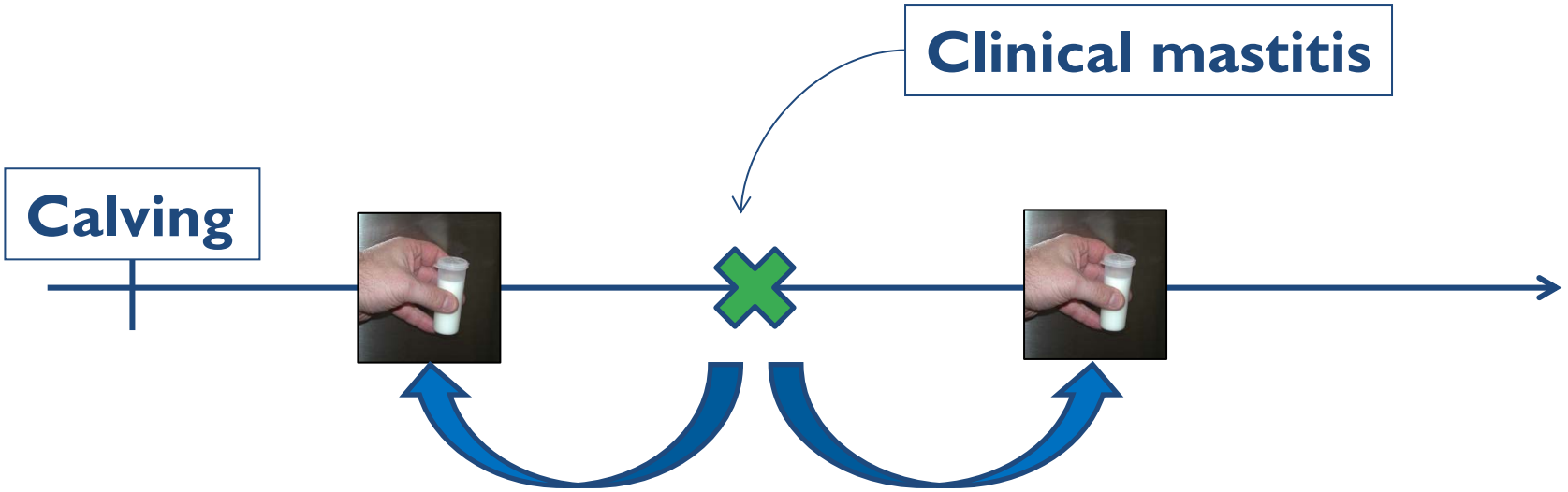
5 groups of mastitis were defined within the edited dataset:

1. **Healthy (Healthy)**
2. **New clinical mastitis (CL-NEW)**
   - → **Cure or no cure**
3. **Chronic clinical mastitis (CL-CH)**
   - → **Cure or no cure**
4. **New sub-clinical mastitis (SUBCL-NEW)**
5. **Chronic sub-clinical mastitis (SUBCL-CH)**

SCC thresholds considered to define sub-clinical cases

- → **1st parity: SCC ≥ 150,000**
- → **2nd and+ parity: SCC ≥ 250,000**

Definitions of mastitis trait



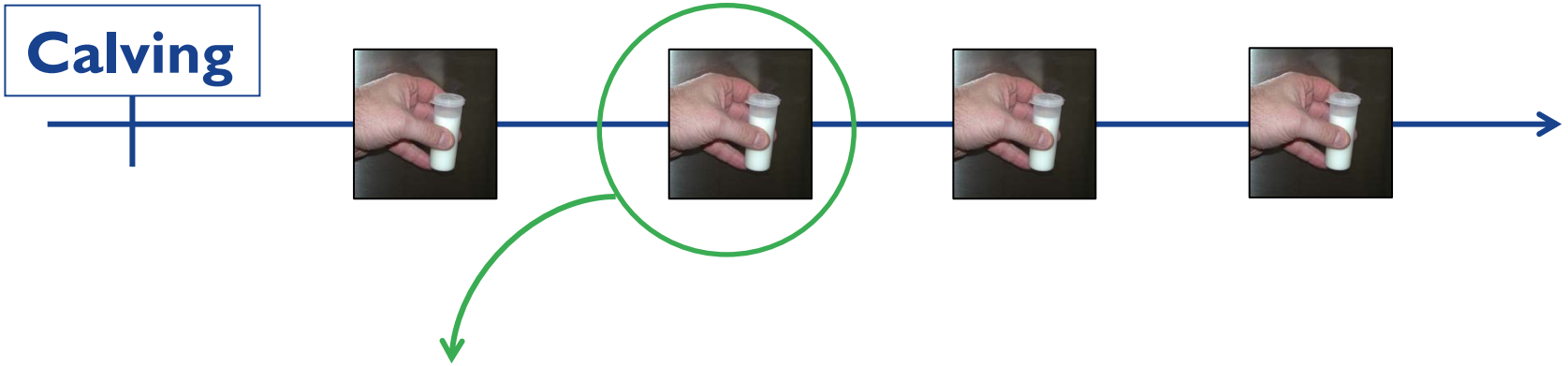
TD from 10 to 45 days before?

- ✓ SCC < threshold ➔ CL-NEW
- ✓ SCC ≥ threshold ➔ CL-CH

TD from 15 to 45 days after?

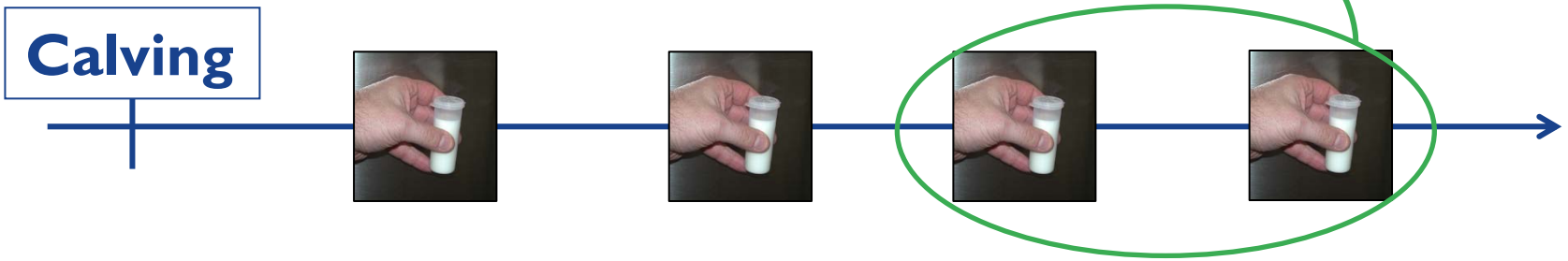
- ✓ SCC < threshold
  - ➔ CL-NEW with cure
  - ➔ CL-CH with cure
- ✓ SCC ≥ threshold
- ➔CL-NEW without cure
- ➔CL-CH without cure

Definitions of mastitis trait



Only one TD with SCC ≥ threshold ➔ SUBCL-NEW

2 consecutive TD with SCC ≥ threshold ➔ SUBCL-CH

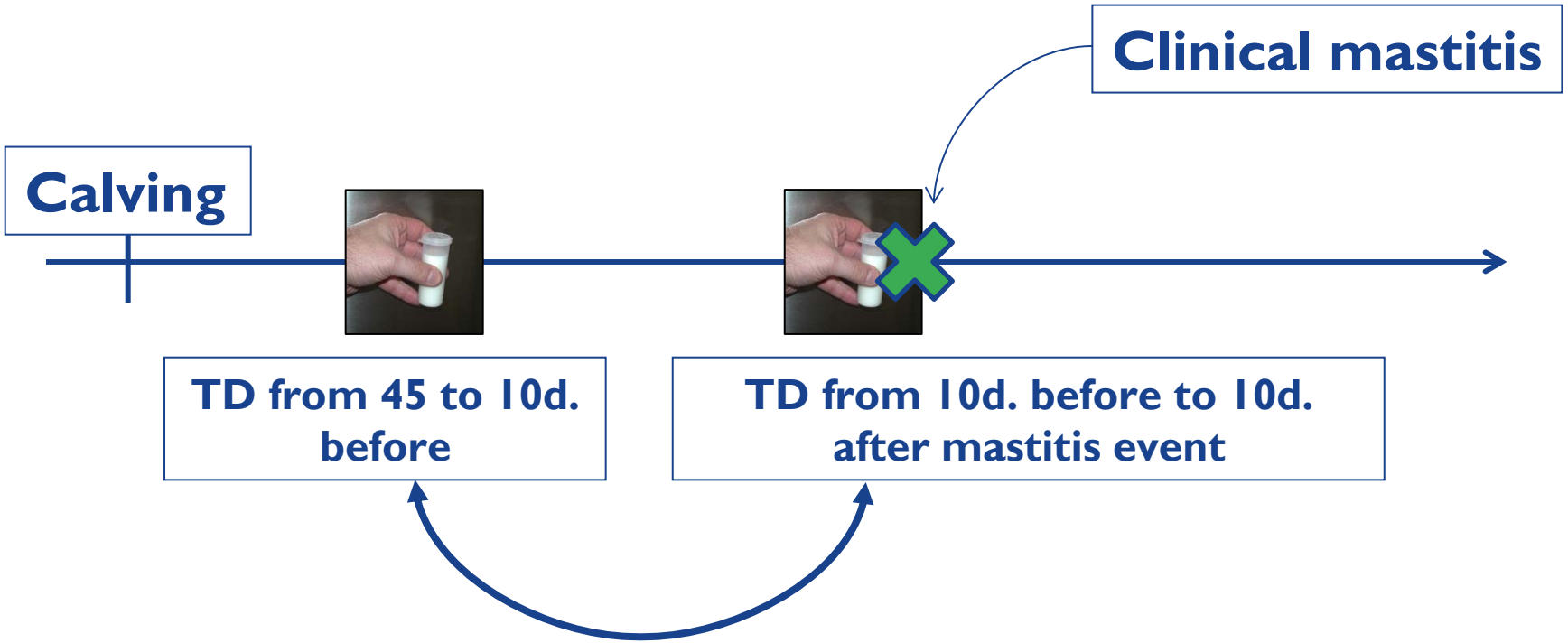


Definitions of mastitis trait

Distribution of lactations (5,191) according to the udder health status group in our dataset

Udder health status group	N	%
Healthy	1,987	38.4
CL-NEW	243	4.6
CL-CH	480	9.2
SUBCL-NEW	1,499	28.9
SUBCL-CH	982	18.9

Changes in milk during mastitis?



Comparisons using paired t-test

➔ 162 data

Changes in milk during mastitis?

Trait	RSQCV(1)	Average difference (during – before)	p-value
Fat (%)		1.187	0.0128
Protein (%)		0.806	0.0002
SCC(2)		818.3	< 0.0001
SCS(2,3)		1.620	< 0.0001
Lactoferrin (mg/L)	0.71	39.57	< 0.0001
Casein (g/100g)	0.94	0.0425	0.0131
Saturated FA (g/dL)	0.99	0.1480	< 0.0001
Short chain FA (g/dL)	0.94	0.0118	0.0094
Medium chain FA (g/dL)	0.97	0.1395	<0.0001
Na (mg/kg)	0.49	10.59	0.0045
Mg (mg/kg)	0.68	1.381	0.0212
K (mg/kg)	0.54	-22.75	0.0039

Predictions by Mid-Infrared spectroscopy

(1) RSQCV: R squared of cross-validation for milk components predicted by MIR
(2) SCC and SCS were not predicted by MIR
(3) SCS is the logarithmic transformation of SCC

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↗ **SCC and SCS**

SCC is a reflection of the inflammatory response to an intramammary infection

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↗ Lactoferrin content

Lactoferrin is an important host defence molecule

→ role in the defence mechanisms in the mammary gland

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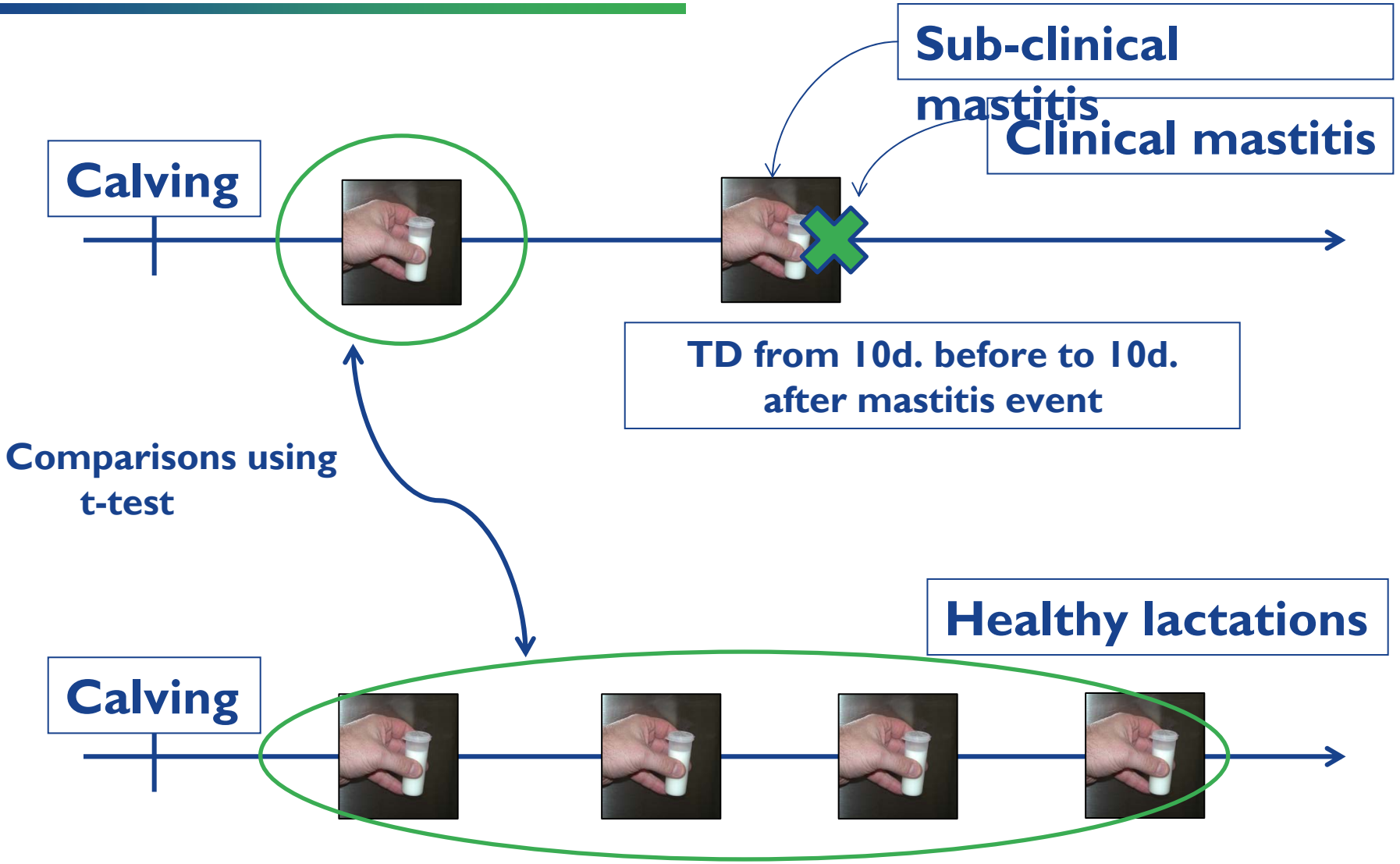
↗ Na but not highly significant

Na is linked with the conductivity

Conductivity is used in AMS when no SCC monitoring is performed

Early indicators in milk?



Early indicators in milk?

Comparisons of milk composition data from a TD occurring before (from 10 to 45d.) a mastitis event (clinical and sub-clinical cases) and milk composition data from healthy lactations

	healthy				before a mastitis			
Trait	N	Mean	Std		N	Mean	Std	p-value
Na (mg/kg)	1,834	347.0	49.4		1,148	359.8	57.3	<0.0001
Lactoferrin (mg/l)	1,589	159.5	74.0		988	170.0	73.5	0.0005
Titratable acidity (Dornic degree)	1,789	16.6	1.5		1,115	16.5	1.5	0.0853
Urea (mg/l)	1,846	248.8	83.9		1,154	240.7	80.7	0.0095

Conclusion

Milk composition predicted by MIR significantly different before and during a mastitis event

MIR predicted traits such as urea, Na, lactoferrin, and titratable acidity were identified as potential early indicators of udder health

No significant differences were observed between milk composition data of cows that recovered from clinical mastitis and milk composition data of cows that were not cured from 15 to 45 days after the mastitis

Perspectives

A comprehensive definition of the different mastitis cases was performed and will allow performing further detailed phenotypic and genetic analysis

Combinations of different predicted milk components will be tested to provide early indicators of risk of mastitis

→ **MIR milk analysis is a quick and inexpensive method already used in routine for traditional traits in the context of the milk recording programs**

Through the OptiMIR project several European milk recording organizations get direct access to MIR data

→ **Allows the development and the implementation of novel management tools based on MIR technology**

Thank you for your attention!

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