Assessment of mammary gland elasticity profiles in dairy cows using once-daily milking

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Cows must adapt to a changing context for the system to survive.
What is an adaptable cow?

- Health
- Reproduction
- Milk production
What is an adaptable cow?

Health

Elastic mammary gland

Milk production

Reproduction
Adaptable cows = cows whose mammary glands are elastic

Elasticity?

Challenge: perturbation of mammary functioning
Adaptable cows = cows whose mammary glands are elastic

Elasticity?

Challenge

Ability to tolerate disruption
Adaptable cows = cows whose mammary glands are elastic

Elasticity?

Challenge

Ability to tolerate disruption

Ability to return to initial state
Need to find a challenge to assess mammary gland elasticity.
Once-daily milking, a suitable challenge to assess mammary elasticity?

Once-daily milking (ODM)
= 1 milking / day instead of 2 (TDM)

- 20 to 30% milk yield
- Changes in milk composition
Once-daily milking, a suitable challenge to assess mammary elasticity?
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- Rapid
- Substantial
- Local
- Reversible
Once-daily milking, a suitable challenge to assess mammary elasticity?

Variability of responses between cows

Discrimination of individuals
Use of 1 day ODM challenge

MÉJUSSEAUME EXPERIMENTAL FARM

5 years

control wk TDM
(d7 to d1 before ODM)

ODM
(d1)

Post TDM
(d7 to d13 after ODM)
Use of 1 day ODM challenge

5 years

control wk TDM (d7 to d1 before ODM)  ODM (d1)  Post TDM (d7 to d13 after ODM)

293 Holstein
Use of 1 day ODM challenge

MÉJUSSEAUME EXPERIMENTAL FARM

5 years

control wk TDM (d7 to d1 before ODM)  ODM (d1)  Post TDM (d7 to d13 after ODM)

293 Holstein

Inter and intra lactation repeated measures n=724 challenges
Use of 1 day ODM challenge

MÉJUSSEAUME EXPERIMENTAL FARM

5 years

control wk TDM (d7 to d1 before ODM)

ODM (d1)

Post TDM (d7 to d13 after ODM)

293 Holstein

Inter and intra lactation repeated measures n=724 challenges

Wide variation of breeding factors
Could 1 day ODM be used to quantify mammary gland elasticity?
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Milk loss
(kg/d, %)

Elasticity  Tolerate disruption  Return to initial state
Could 1 day ODM be used to quantify mammary gland elasticity?

**Elasticity**
- Milk loss (kg/d, %)
- Milk recovery (kg/d)
- Milk recovery : loss ratio (%)

**Tolerate disruption**

**Return to initial state**
Could 1 day ODM be used to quantify mammary gland elasticity?

Milk loss (kg/d, %)

Milk recovery (kg/d)

Milk recovery : loss ratio (%)

Elasticity

Tolerate disruption

Return to initial state

① Response profiles

② Breeding factors

Stage of lactation, parity, age at first calving ...
Could 1 day ODM be used to quantify mammary gland elasticity?

- Milk loss (kg/d, %)
- Milk recovery (kg/d)
- Milk recovery : loss ratio (%)

- Elasticity
  - Tolerate disruption
  - Return to initial state

① Response profiles

② Breeding factors
  - Stage of lactation, parity, age at first calving ...

→ PCA followed by clustering (HCPC)
ODM generates a wide variability of responses

Average milk loss: -6.3 kg/d (-21.3 %)
Average milk recovery: 4.8 kg/d
ODM generates a wide variability of responses

The greater the milk loss, the greater the milk recovery
ODM generates a wide variability of responses

The greater the milk loss, the greater the milk recovery

\[ y = -1.07x - 1.67 \]
\[ R^2 = 0.80 \]
\[ RSD : 2.1 \text{ kg/d} \]
ODM generates a wide variability of responses

88% of the cows lost milk during ODM and recovered milk when resuming TDM
ODM generates a wide variability of responses

11 % of the cows lost milk during ODM and continued to lose milk when resuming TDM
ODM generates a wide variability of responses

$$y = -1.07 \times -1.67$$
$$R^2 = 0.80$$
$$RSD : 2.1 \text{ kg/d}$$

3 % of the cows gained milk when switched to ODM but lost milk when resuming TDM
ODM generates a wide variability of responses

Calculation of milk recovery: loss ratio $\rightarrow$ PCA and HCPC
PCA results

Variables factor map (PCA)

Dim 1 (68.86%)
Dim 2 (26.62%)

Milk recovery:loss ratio
Recovery
Relative_loss
Loss

Rate_recovery

Relative_loss
Rate_recovery
LossRecovery
Relative_loss
Rate_recovery
LossRecovery
Relative_loss
Rate_recovery

Loss
Relative_loss
Recovery
Milk recovery:loss ratio

The greater the milk loss, the greater the milk recovery

Variables factor map (PCA)

Dim 1 (68.86%)
Dim 2 (26.62%)

Milk recovery:loss ratio

Negative correlation between milk loss and milk recovery
Milk loss and milk recovery: loss ratio may be independent

Variables factor map (PCA)

Dim 1 (68.86%)

Dim 2 (26.62%)

Orthogonality
ODM generates different response profiles
Cows with first calving at 24 months were only characterized by showing an average loss

CLUSTER 1, n=215
Early first calving
+/- milk loss (7.8 kg/d; 27%)
Early lactation cows lost more milk but recovered completely.

Cluster 2, n=123
< 50 DIM
+ milk loss (12.5 kg/d; 37 %)
+ milk recovery (12.1 kg/d)
Milk recovery:loss ratio: 98 %
Cows with a low potential milk yield level with a stage of lactation > 180 DIM lost less and recovered less.

**CLUSTER 3, n=244**

- Low potential milk yield level
- Middle-late lactation
- Milk loss (4.4 kg/d; 17%)
- Milk recovery (3.08 kg/d)
- Milk recovery:loss ratio (69%)
Cows with a stage of lactation > 50 DIM combined a limited milk loss and a great recovery

CLUSTER 4, n=38
Stage of lactation > 50 DIM
- milk loss (3.5 kg/d; 12 %)
+ milk recovery:loss ratio: 161 %
Cows with a stage of lactation > 50 DIM combined a limited milk loss and a great recovery.

Wasn’t found to be repeatable from one challenge to another.
The same profiles were observed for milk yield losses and recoveries corrected for the breeding factors.
Conclusions
Mammary elasticity profiles can be assessed by using an ODM challenge.

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Cluster 2

Ability to tolerate disruption

Ability to return to initial state

<50 DIM
Mammary elasticity profiles can be assessed by using an ODM challenge

- Ability to tolerate disruption
- Ability to return to initial state

Cluster 2
Cluster 3

Milk yield

<50 DIM

> 180 DIM
Mammary elasticity profiles can be assessed by using an ODM challenge.
Mammary elasticity profiles can be assessed by using an ODM challenge.

Same profiles observed when correcting for breeding factors.
Once-daily milking, a relevant challenge to assess mammary elasticity

**What I presented**

- Phenotypes
- Plasticity profiles & Breeding factors
- Prediction of mammary elasticity
- Selection of adaptable cows
- Evaluation of genetic determinism
Once-daily milking, a relevant challenge to assess mammary elasticity

 Phenotypes

 Plasticity profiles & Breeding factors

 Evaluation of genetic determinism

 Extension to phenotypes study

 Prediction of mammary elasticity

 Selection of adaptable cows
Once-daily milking, a relevant challenge to assess mammary elasticity

Phenotypes

Plasticity profiles & Breeding factors

Prediction of mammary elasticity

Evaluation of genetic determinism

Selection of adaptable cows

Extension on longer ODM & stage of lactation constant and genetic determinism
Once-daily milking, a relevant challenge to assess mammary elasticity

Phenotypes

Plasticity profiles & Breeding factors

Evaluation of genetic determinism

Prediction of mammary elasticity

Identification of adaptable cows
Mammary elasticity profiles can be assessed by using an ODM challenge.

- **Ability to tolerate disruption**
- **Ability to return to initial state**

Any questions?