# Use of PLF sensors to monitoring rumination as an alternative for early clinical mastitis detection

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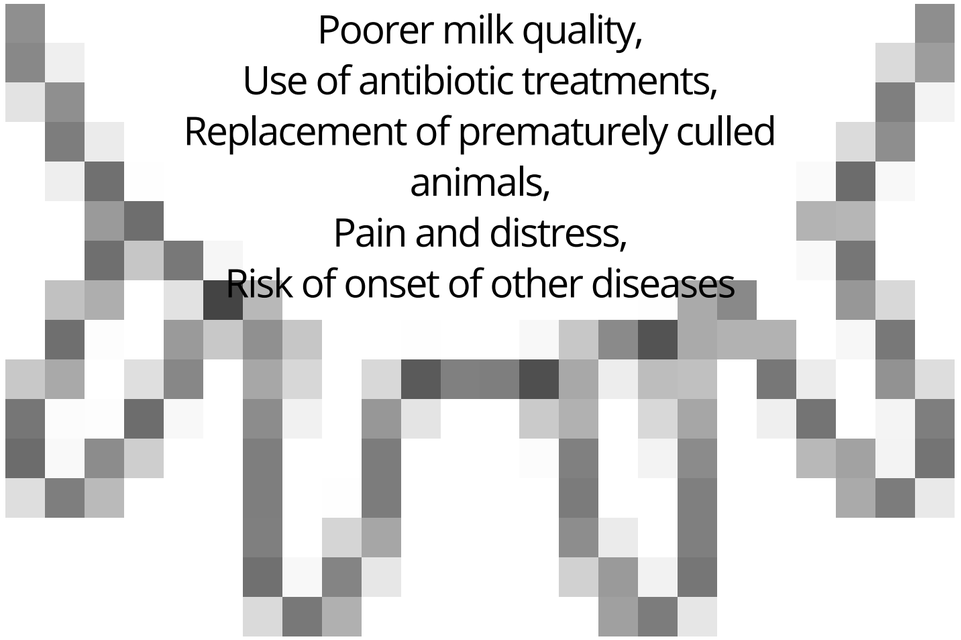
# Introduction

The incidence of mastitis has not changed over the last decade.
Mastitis is still one of the most important and frequent disease in dairy industry with significant economic loss and severe animal welfare implications.

Production losses,
Poorer milk quality,
Use of antibiotic treatments,
Replacement of prematurely culled animals,
Pain and distress,
Risk of onset of other diseases



Bar et al., 2008; Cobirka et al., 2020; Halasa et al., 2007; Hogeveen et al., 2011; Macrae et al., 2015; EFSA, 2023

# Introduction

Multifactor disease that results from **mammary gland inflammation**.

The severity of the inflammation and the presence of symptoms distinguishes sub-clinical from clinical mastitis.


**Milk alteration**
Changes in colour
Presence of clots, flakes

**Gland modification**
Changes in tissue colour, swelling

**Changes in animal status**
High body temperature,
Loss of appetite,
Altered hydration level

De Vliegher et al., 2018; Adkins and Middleton, 2018; Ashraf and Imran, 2018; Martins et al., 2019

# Introduction

The actual ability of **traditional approaches** to identify the **very early stages** of the onset of mastitis or predict the likelihood of mastitis in healthy cows **is limited** (e.g., costs and time consuming for lab analysis).

Mastitis can **affect** the **behavioural time-budget** of dairy cows (i.e., reduction in feeding and ruminating, decreasing lying time, decreasing activity time). **Ruminating** appears to be particularly **sensitive** to mastitis.

These **behavioural changes** are an **adaptative response** called "**sickness behaviour**" and can be detected by **precision livestock farming** (PLF) (e.g., accelerometers' technology) and can be used to **develop** an innovative, reliable, and cost-effective **tool for early detection** of mastitis.

Johnson, 2002; Donadeu et al., 2020; Fogsgaard et al., 2015; Sepulveda-Varas et al. 2016; Siivonen et al., 2011; Medrano-Galarza et al., 2012

# Aim

The aim of this study was to clarify whether a decreased rumination time, monitored with accelerometery collars, can predict the onset of mastitis in lactating dairy cows.

# Materials and Methods

A total of **28 Friesian dairy cows**, housed in two different **intensive free-stall farms** located in **Italy** (Lombardy region) and in **Spain** (Andalucía), were recruited and divided in **two groups** balanced for stage of lactation, parity order.

## Mastitis group

- 14 lactating cows: 9 from Italy and 5 from Spain
- 6 primiparous and 8 pluriparous
- N of lactation: from1 to 6
- Phase of lactation:
  - 9 cows >90 d of lactation
  - 3 cows 30-90 d of lactation
  - 2 cows 15 d before delivery-30 d of lactation
- Average milk production 34.2L/d

## Control group

- 14 lactating cows: 9 from Italy and 5 from Spain
- 8 primiparous and 6 pluriparous
- N of lactation: from 1 to 3
- Phase of lactation:
  - 11 cows >90 d of lactation
  - 2 cows 30-90 d of lactation
  - 1 cows 15 d before delivery-30 d of lactation
- Average milk production 37.4L/d

## Diagnosis

Mastitis was diagnosed through milk alterations (e.g., presence of flocks, change in colour) and clinical examination.

## Treatment

All mastitic cows were treated with antibiotics (3 days).

# Materials and Methods

- Data collection was carried out for **three months** (from February to May 2021).
- All cows were fitted with an **accelerometery sensors** mounted on a **collar**.
- For each cow, daily hours spent **ruminating** was monitored for a total of **21 days**:
  - **10 days prior the diagnosis**
  - **The day of diagnosis**
  - **10 days after the diagnosis.**
- The **same time-frame** was considered for the **control group**.
- **Health** (e.g., surgery, antibiotic treatment, disease onset) and **productivity** (e.g., daily milk production) **data** was collected in the same time frame.

An ANOVA for repeated measures with Bonferroni post hoc test was performed to identify differences between groups at each timepoint.

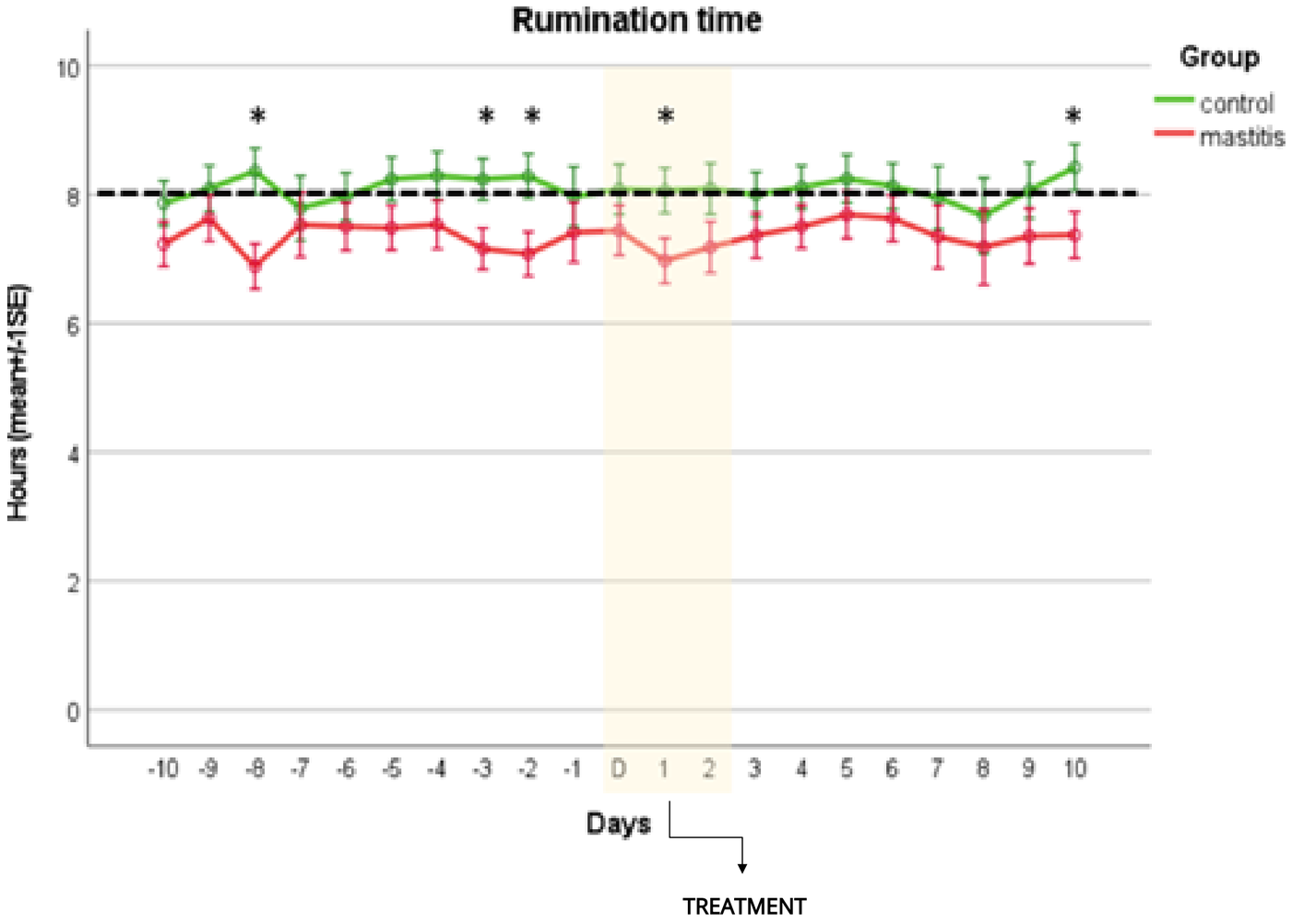
# Results

A repeated-measures ANOVA determined that mean Rumination time and the interaction between Days and Group differed significantly across the days
(F= 4.200 and p=0.030, F=5,518 and p=0.014 respectively).

A post hoc pairwise comparison using the Bonferroni correction showed differences between the mastitis and control group at D-8, D-3, D-2, D1 and D10.

This analysis showed that both groups are clearly separated:
the control group remained around the threshold of 8hs whereas the mastitis group was always under threshold.

Adin et al., 2009; Gomez et al., 2010



# Discussion and Conclusion

A decrease in **rumination time** can be a **valuable and reliable early indicator** of clinical mastitis and also a **useful tool** to monitor the **recovery**.

Siivonen et al., 2011; Fogsgaard et al., 2012; Soriano et al., 2012; Stangaferro et al., 2016; King et al., 2018; Dittrich et al., 2019; Berteselli et al., 2022)

The release of **inflammatory mediators** that regulate the release of inflammatory cells on the damaged tissue regulated by the hypothalamus, presumably **activating the satiety center**, could be a feasible explanation for decrease of rumination.

Radostits et al., 2007; Antanaitis et al., 2022

About the separation between groups considering rumination time threshold, it could be speculated that the **mastitic cows may have already been sick,** maybe with undetected **subclinical form**, or these animals could **have behavioural patterns** which expose them to an **increased risk of mastitis.**

Moreover, returning to normal rumination pattern could require more time than clinical recovery.

# Discussion and Conclusion

The **dimensions of the behavioural changes** are very **individual**, as a sick cow could express major changes in its behaviour, while another sick cow expresses only slight deviation although the diagnosis is the same for both individuals

Dittrich et al., 2019

Readily **intercepting** and **recognising** these **behavioural changes** can be useful in developing an **early detection system** to identify cows suffering from mastitis and to **improve animal welfare**.

EFSA, 2012

The **detection system** should be consider the **behavioural thresholds** of the dairy cow or **comparing the animal with itself** in several time points, with respect to a given reference point.

The **accelerometric technology** offers a significant opportunity to implement an **automated mastitis-monitoring system** using **rumination** for an early detection of mastitis outbreak.

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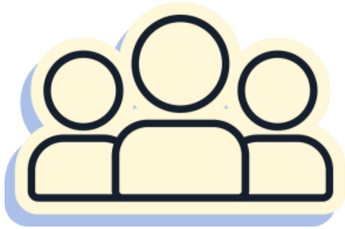

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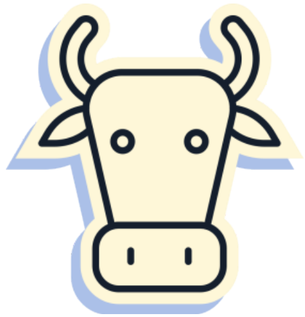

All the cows involved in the project

# Thank you for your attention!

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