# Milk calcium content to detect hypocalcaemia in dairy cows at the onset of lactation

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# A need for easy-to-use tests to detect dairy cows in Hypocalcaemia at the onset of lactation

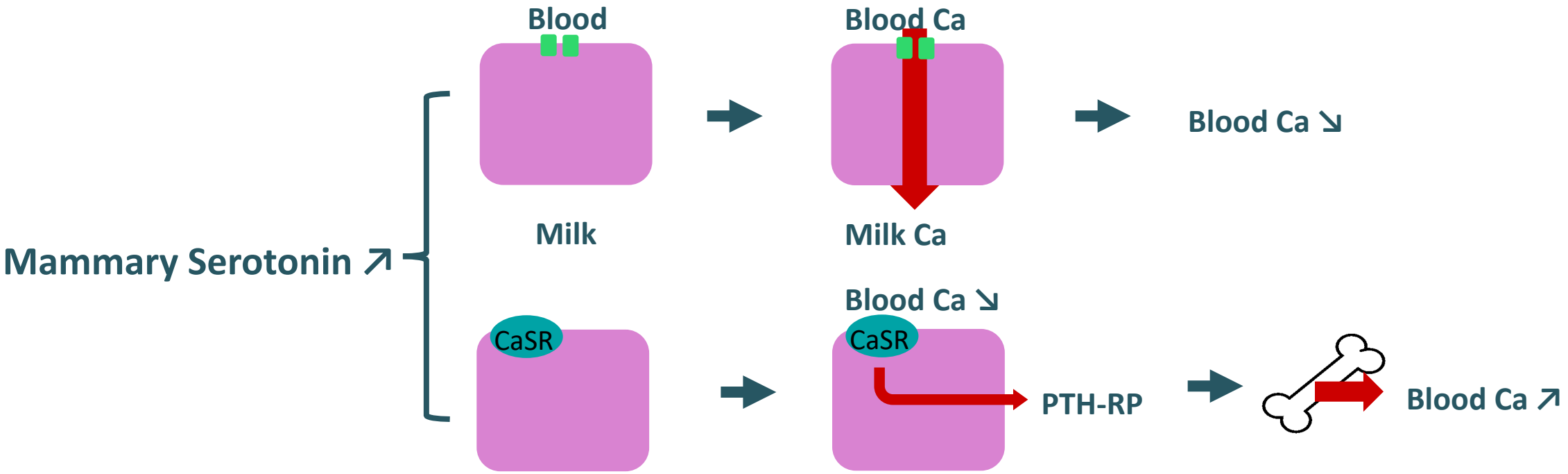
- Hypocalcaemia, a major health issue in dairy cows
  - Occuring at the onset of lactation with a high prevalence: **33-65 %**
  - detrimental effects on health

- Diagnostic issue is of great interest, due to the subclinical nature of hypocalcaemia
  - To detect herds with high prevalence
  - To assess health effects of preventive strategies

- Blood sampling on farm is inconvenient and impracticable
  - Technical constraint for farmers: time consuming, sampling method
  - High cost of handled analysers / moderate performances

# Milk Ca content could be correlated to levels of blood Ca at the onset of lactation

- Ca secretion into milk is regulated based on blood calcium content
  - Controlled by mammary **serotonin** (Hernandez, 2017)




- Low cost (M.I.R.), easy to sample



→ Performances of milk Ca to detect cows in hypocalcaemia?

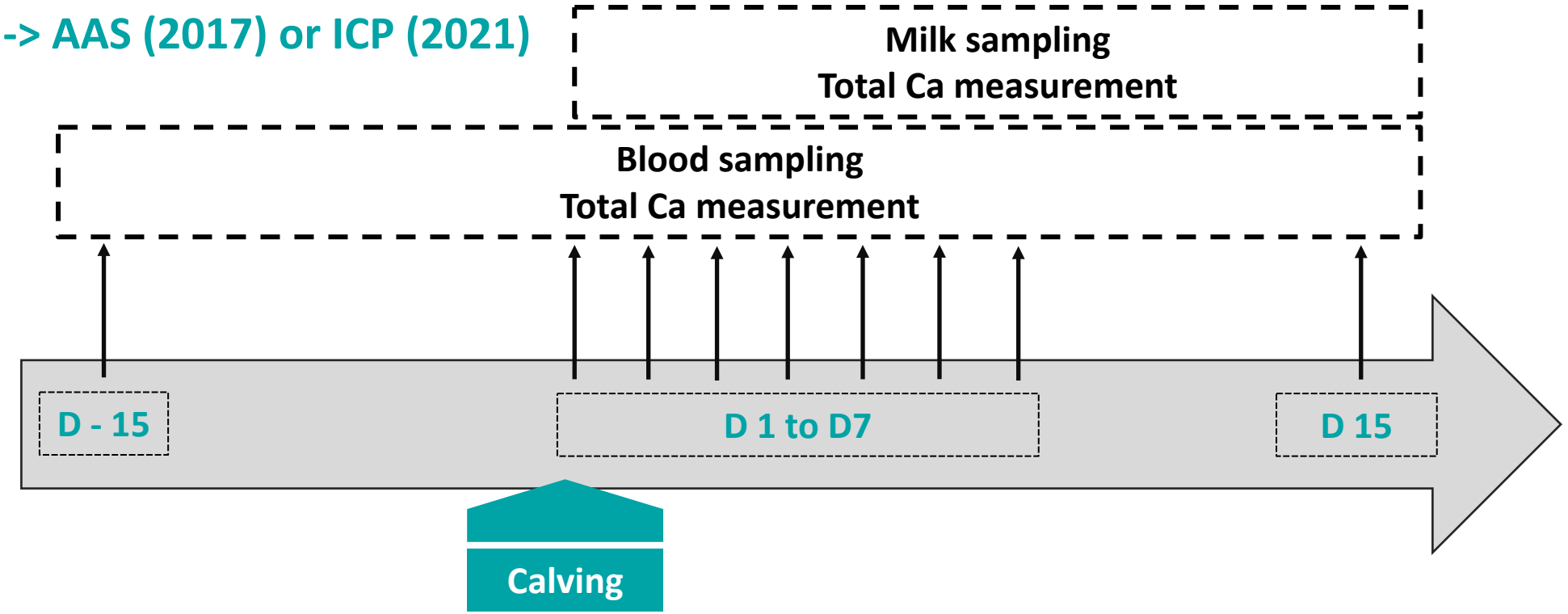
# Objectives

**To assess the ability of milk calcium content to detect cows in SHC**

- Describe milk and blood Ca dynamics
- Identify days with strong correlations
- Assess performances

# Materials and methods : Longitudinal study in experimental conditions

- **50 Holstein dairy cows around calving, Méjusseaume farm (INRAE) :**
  - 2017 (n=20) and 2021 (n=30)
  - 18 primiparous and 32 multiparous
- Enrolled 15 days before expected calving and followed until 15 days after calving
- Milked twice daily -> **Morning sampling** (milk sampler throughout the milking)
- **Ca measurement -> AAS (2017) or ICP (2021)**



# Material and methods : Strategy of analysis

- **Description of milk and plasma Ca dynamics:**
  - PROCGLIMMIX (GLMM with repeated values)

$$Yijk = * \mu + Expi + Dayj + Exp : Day\ ij + cowk + €ijk$$

- **Study of correlation between milk and plasma**
  - Spearman rho Matrix
- **Ability of milk Ca content to detect hypocalcaemia:**

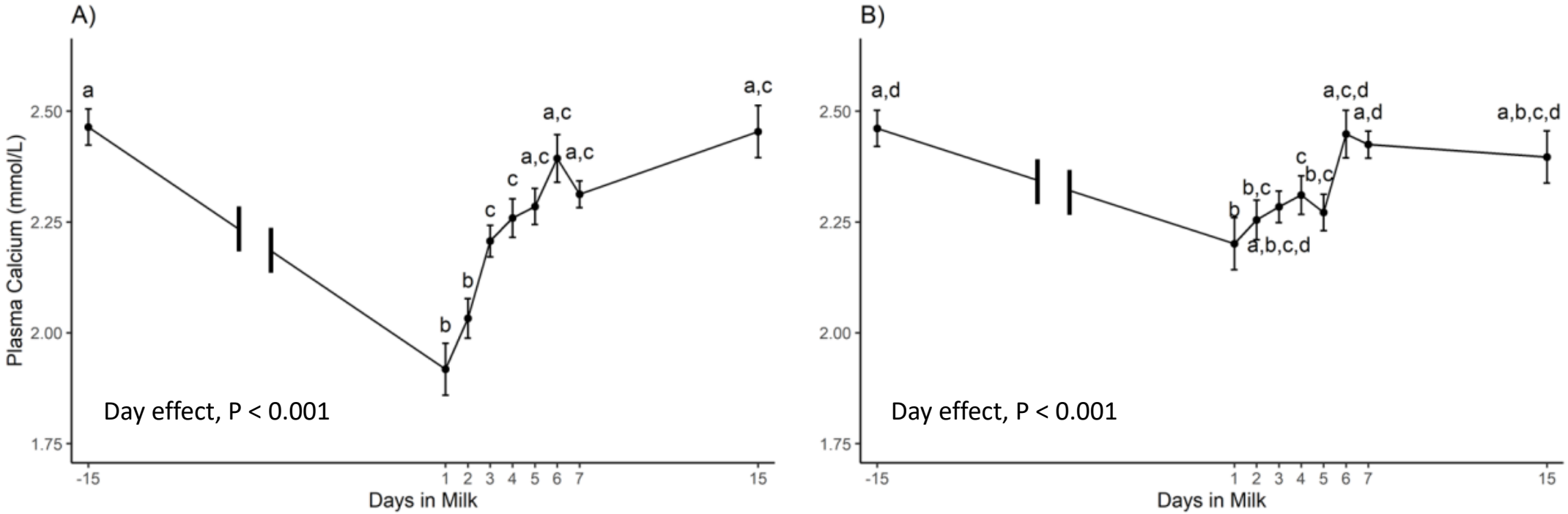
  -> Reference method = hypocalcemia patterns :
    - Caixeta et al., 2017
    - McArt and Neves, 2019

  -> ROC analysis for each « milk sampling day »

| Pattern | High Risk | Low Risk |
|---|---|---|
| Caixeta | Blood Ca < 2.0 mmol/l on days 1, 2, 3 | Other combinations |
| McArt-Neves | Persistent hypocalcaemia<br>Delayed hypocalcaemia | Transient hypocalcaemia<br>Normocalcaemia |

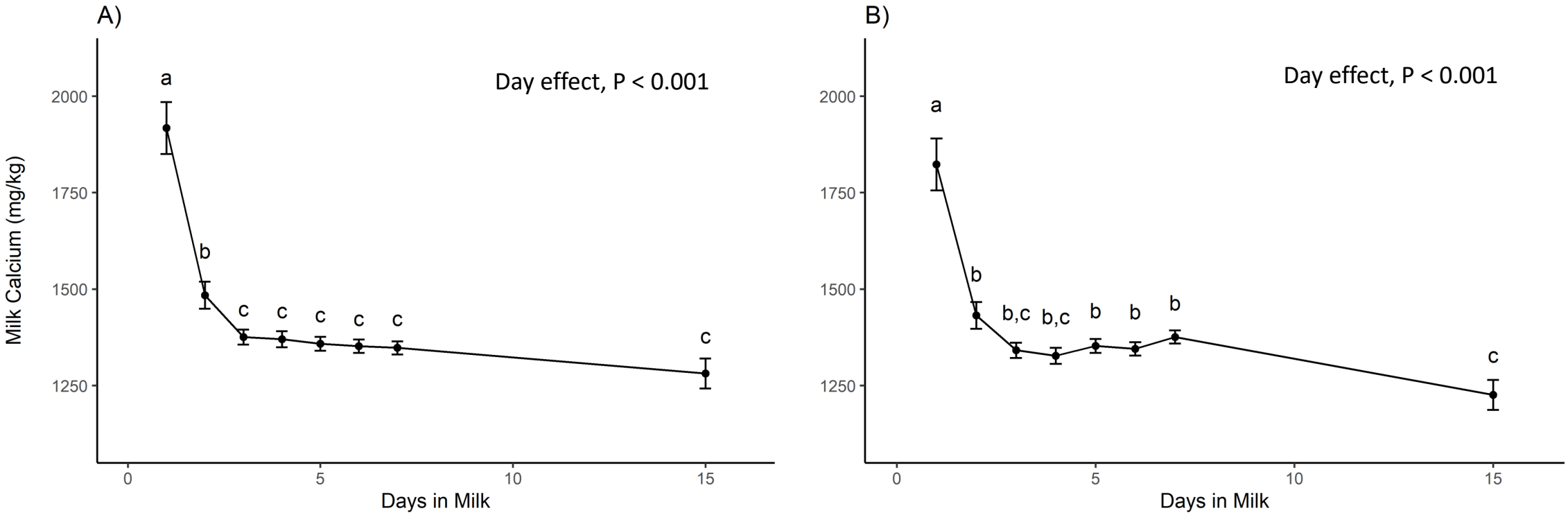
# Results : Dynamics of plasma Ca show lowest values at days 1 and 2

Least square means and standard errors of plasma calcium content from two weeks before the expected date of calving to two weeks after calving for A) 32 multiparous cows and B) 18 primiparous cows.



# Results : Dynamics of milk Ca content show a strong decline from day 1 to day 3

Least square means and standard errors of milk calcium content during the first two weeks of lactation for A) 32 multiparous cows and B) 18 primiparous cows.

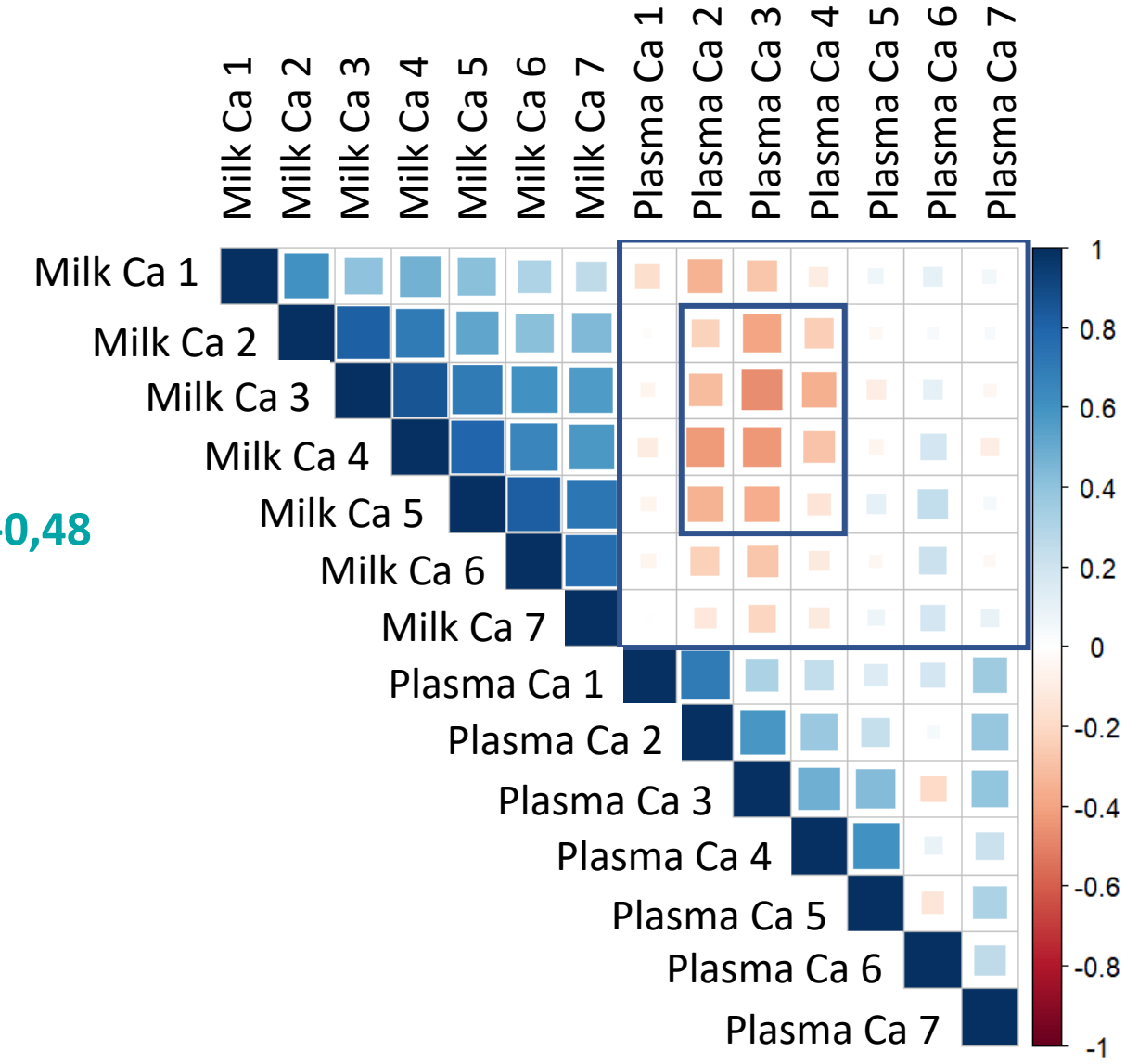


# Results : Low to moderate correlations between milk and plasma Ca

**50 cows**

- **Significant correlations** between
  - Plasma Ca on days 2-4 and
  - Milk Ca on days 2-5

- Milk Ca 4 and Plasma Ca 3 -> **Spearman rho = -0,48**
- Slight differences primiparous/multiparous



# Moderate to high accuracy of individual milk calcium content as a predictor of SHC risk

**49 cows, Milk Day = 4**

| Type of SHC pattern | Milk Ca content cut-off value (mg/kg) | Cows in High Risk category | Sensitivity % [95% CI] | Specificity % [95% CI] | AUC |
|---|---|---|---|---|---|
| Caixeta | 1403 | 10 | 90.0 [56;100] | 79.5 [61;89] | 0,79 |
| McArt-Neves | 1395 | 13 | 84.6 [55;98] | 80.6 [64;92] | 0,76 |

# Conclusion and research opportunities

- Negative correlations between plasma and milk Ca could be the sign of the regulation abilities of cows

**Remaining issues on regulation mechanisms**

-> Regulation dynamics is not well known

-> Contribution of mammary regulation to overall homeostasis is not well known

→ Regulation **dynamics** need to be investigated (transcriptomics on mammary epithelial cells)

# Conclusion and research opportunities

- Milk Ca content on day 4 could be an indicator of hypocalcaemia

**Restricted numbers of cows / only 1 farm**

-> Lack of precision in the estimates: number of individuals, genetic and feeds variability (Weaver et al., 2016, Gaignon et al., 2018)

-> No validation of the model on an additional data set

→ Need for studies **in broader conditions**

# Thanks to colleagues !

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