

Milk spontaneous lipolysis in dairy cows : variation factors and biochemical mechanisms

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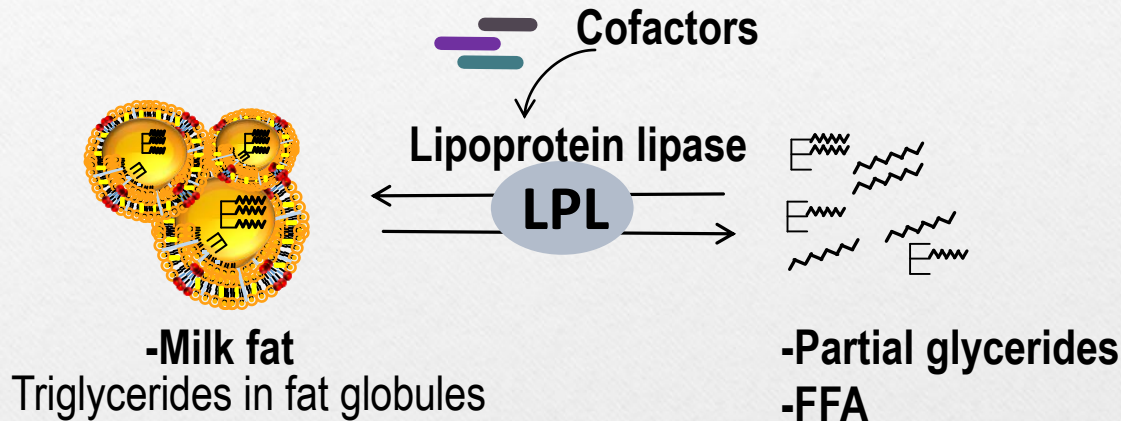


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SPONTANEOUS LIPOLYSIS ?

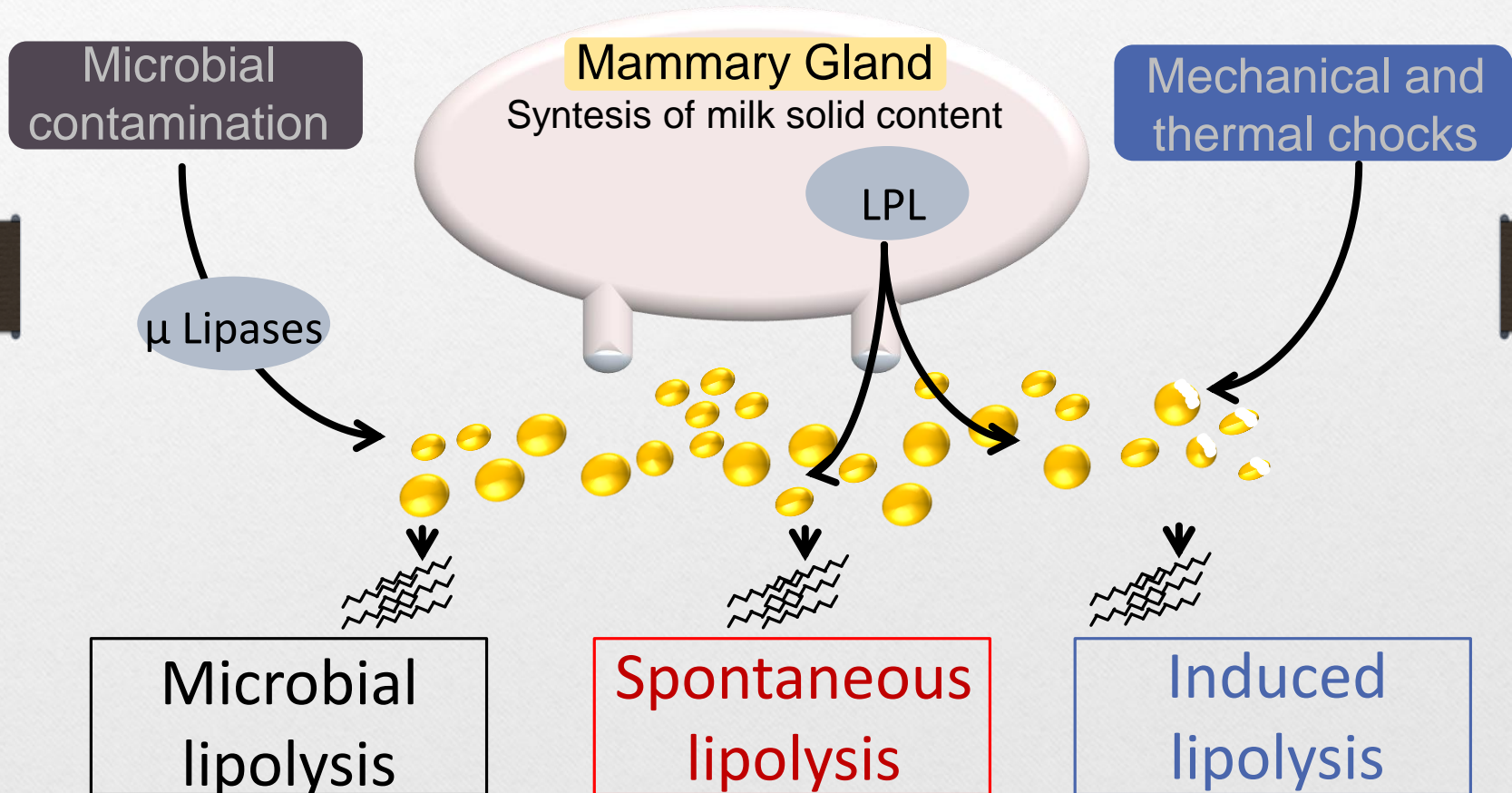
- **Lipolysis** = Enzymatic hydrolysis of triglycerides into glycerol and free fatty acids (FFA) by lipoprotein lipase



- **Evaluation of lipolysis** : Titration of FFA
mEq/100 g of fat = mmol/100 g of fat

SPONTANEOUS LIPOLYSIS ?

- Three **types of lipolysis** are defined :



LIPOLYSIS, A ZOOTECHNICAL PROBLEM

- FFA are responsible for off-flavour (oxidized) in milk and dairy products (Mac Leod et al., 1957 ; Connolly et al., 1979 ; Santos et al., 2003)
- Partial glycerides and FFA are responsible for technological abilities impairment (Buchanan, 1965 ; Deeth and Fitzgerald, 1995 ; Deeth, 2006)
- Lipolysis is a milk quality issue and an economical issue (farmers, dairies)
- Key figures:
 - **1.2 – 1.5 mEq/100 g fat: threshold of acceptance for consumers** (Chilliard & Lamberet, 1984 ; Santos et al., 2003 ; IDF)
 - **0.89 mEq/100 g fat: threshold for milk payment to farmers** (CNIEL) – **2 to 15% of farmers penalized** according the period of the year.
- Quality problems cannot be harness by the downstream part of the sector (techn. Imposs.).



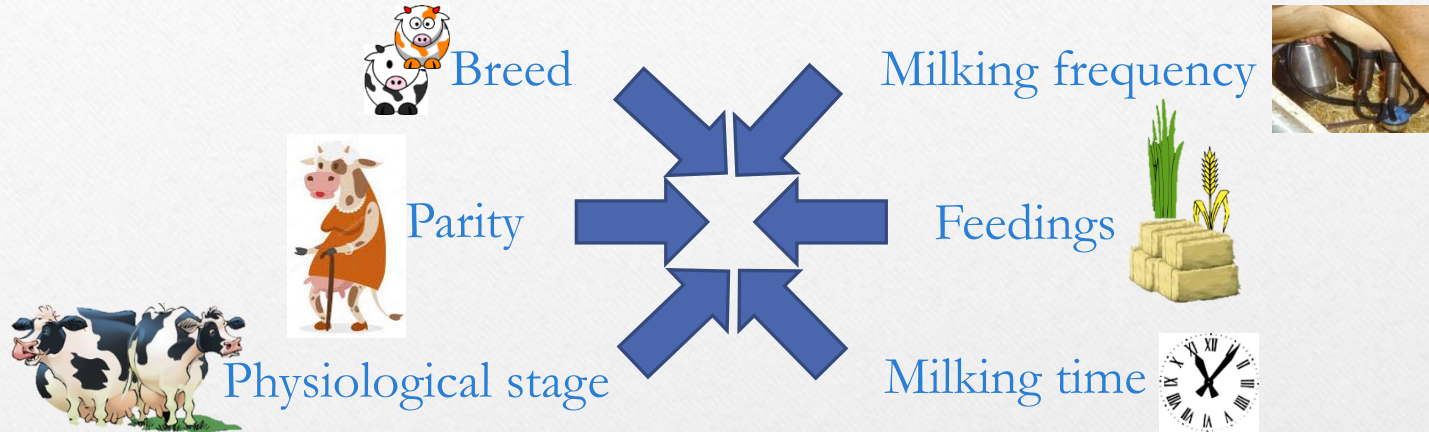
SCIENTIFIC PROBLEM :

1- Which husbandry factors are modulating spontaneous lipolysis ?

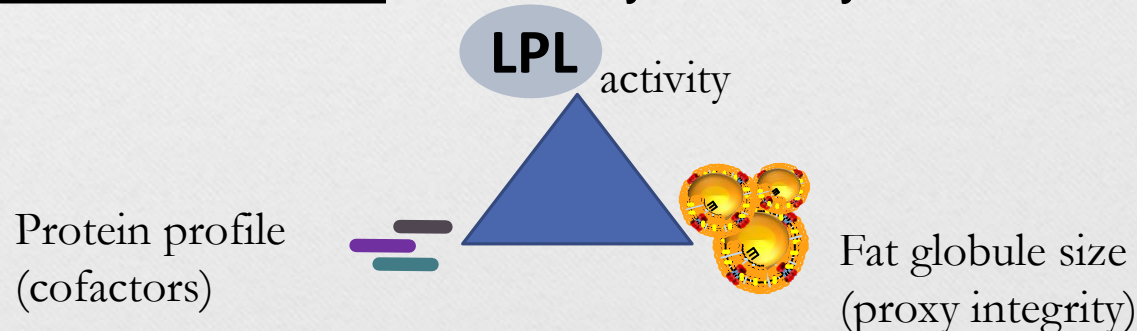
2 - What are the biochemical mechanisms ?



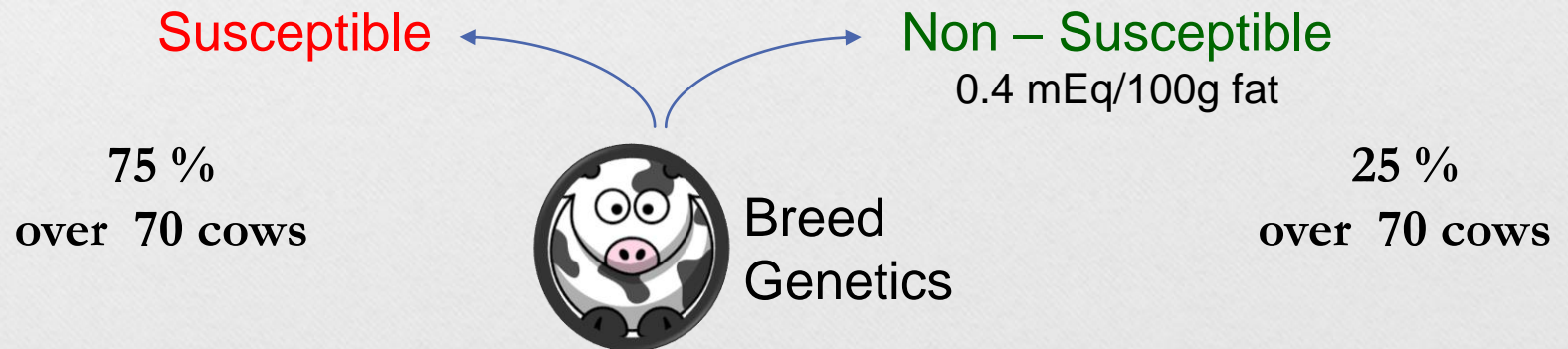
- **5 trials** (4 continuous designs – 1 cross over) – Linear models
- **Inherent and husbandry factors** assessed :



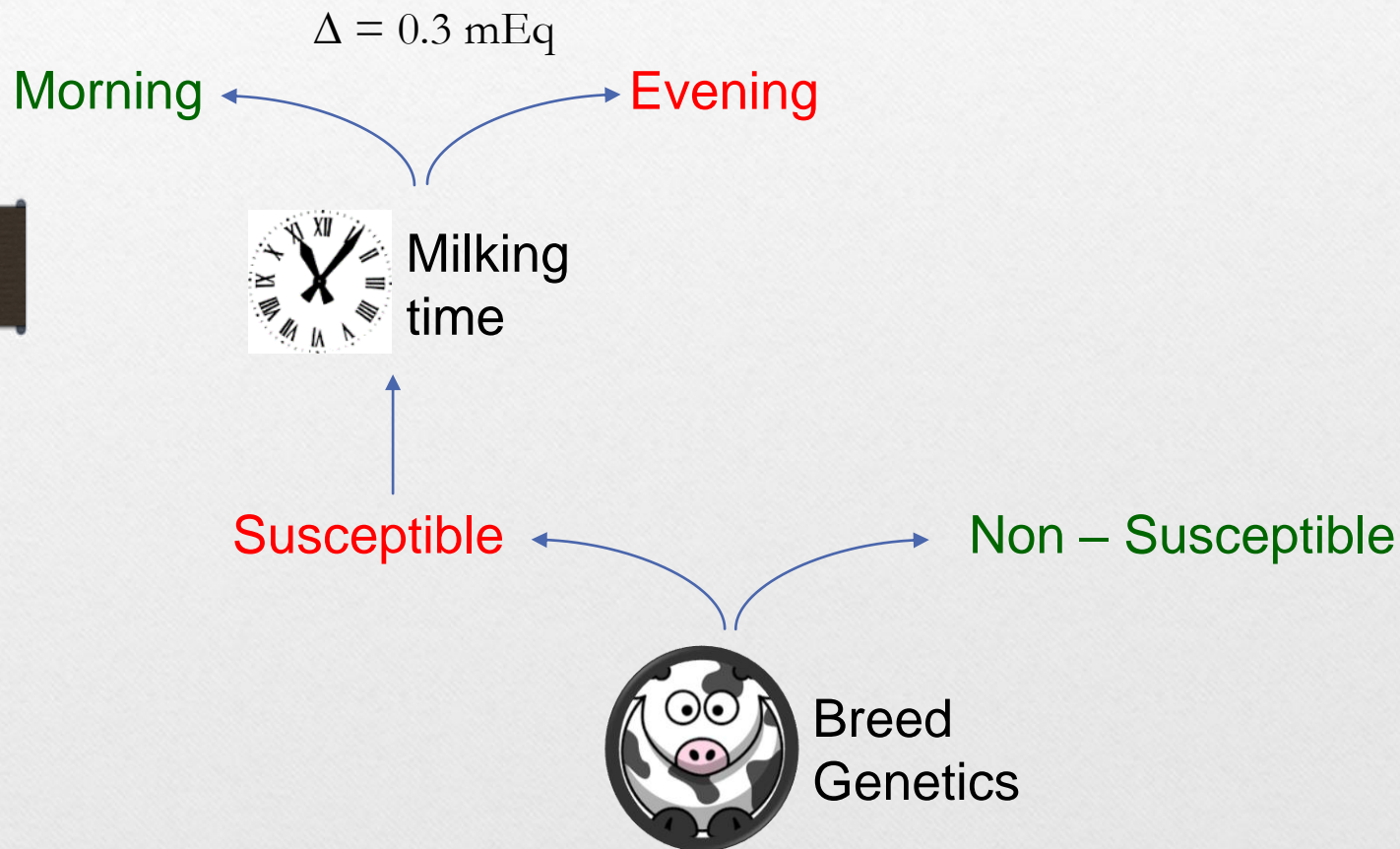
- **Biochemical factors** = all enzymatic system :



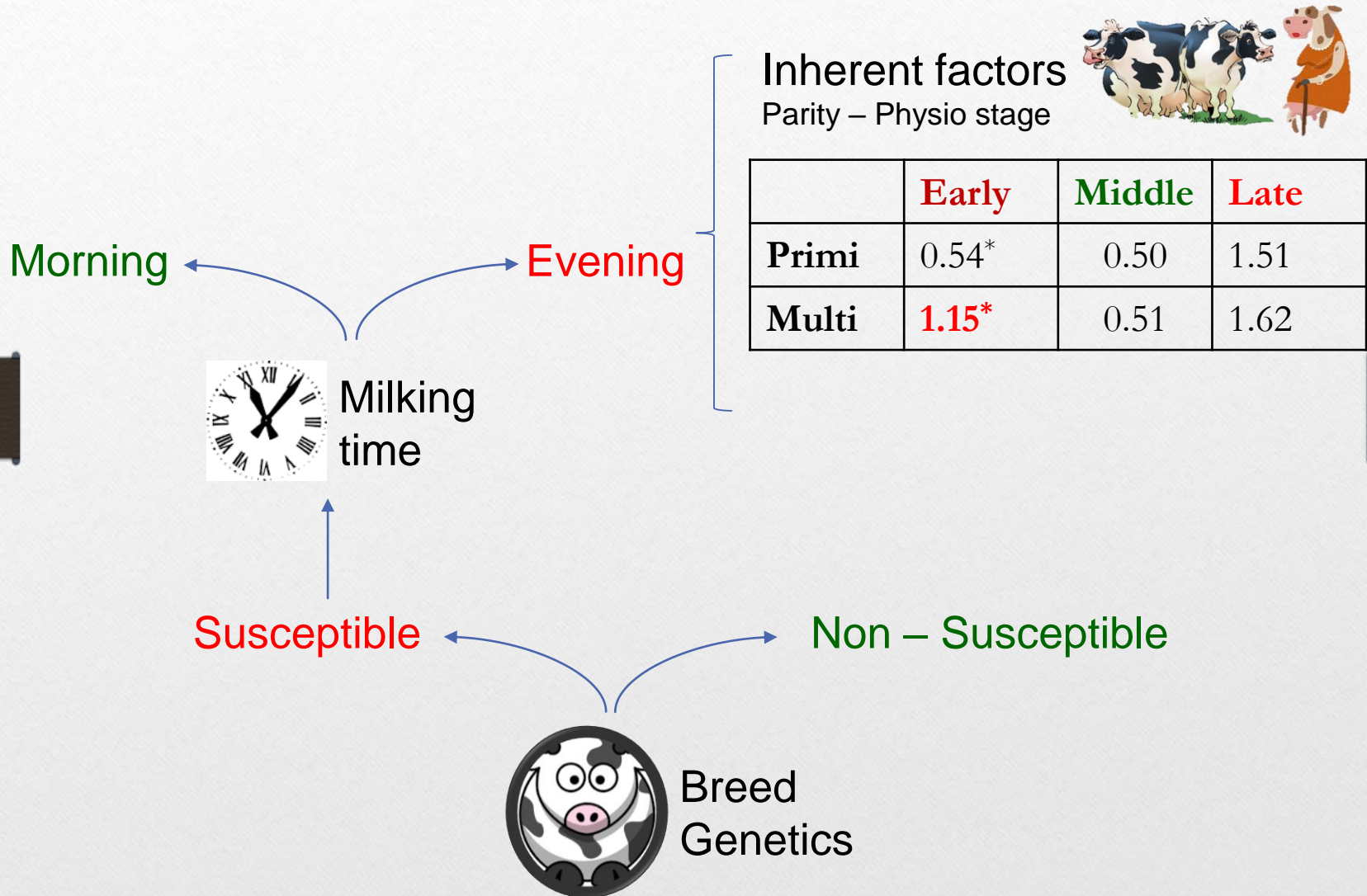
AT A ZOOTECHNICAL LEVEL



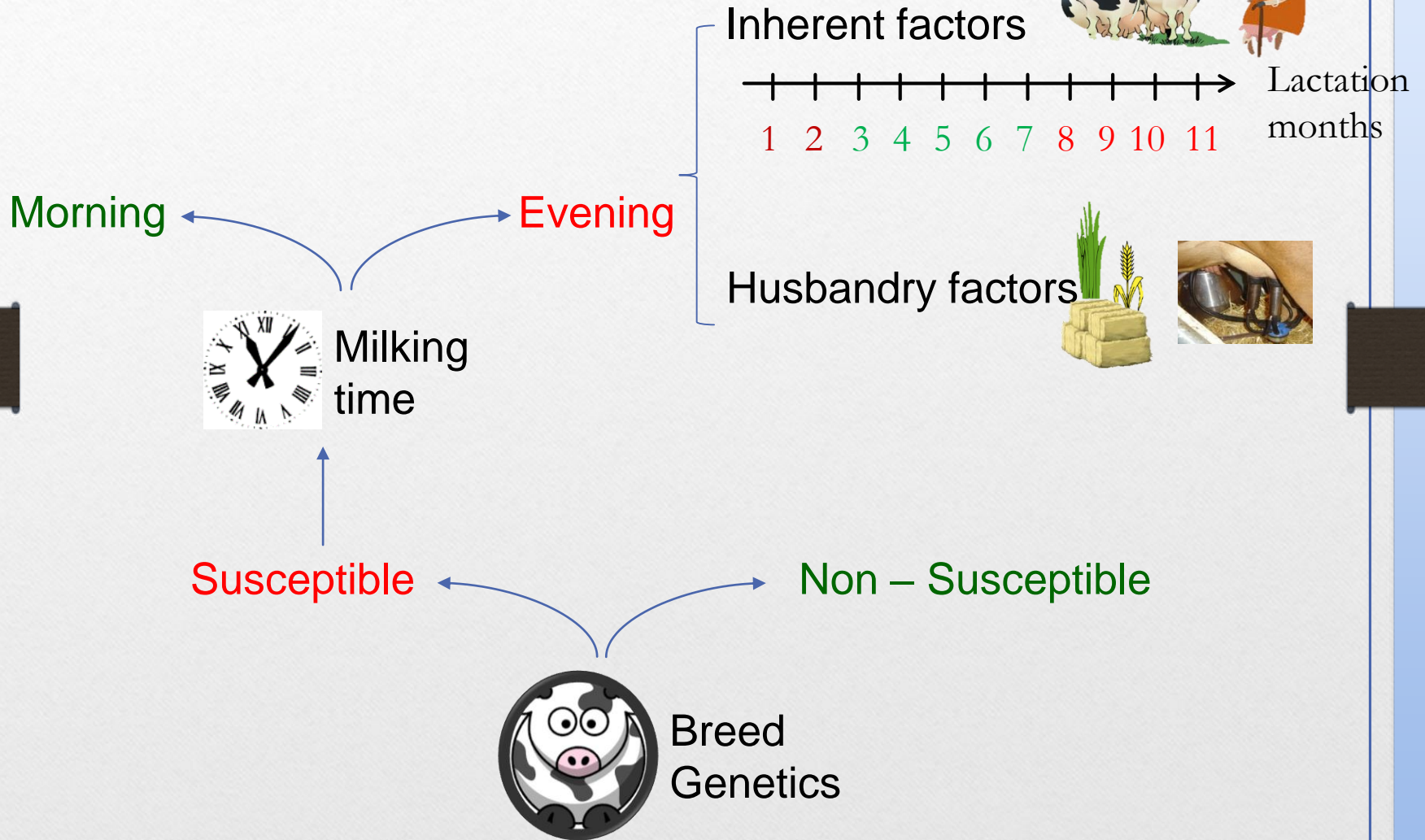
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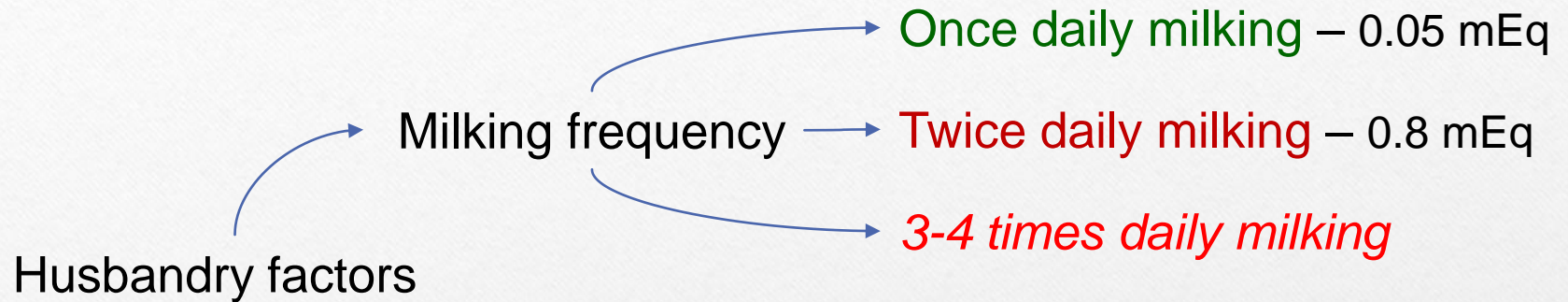
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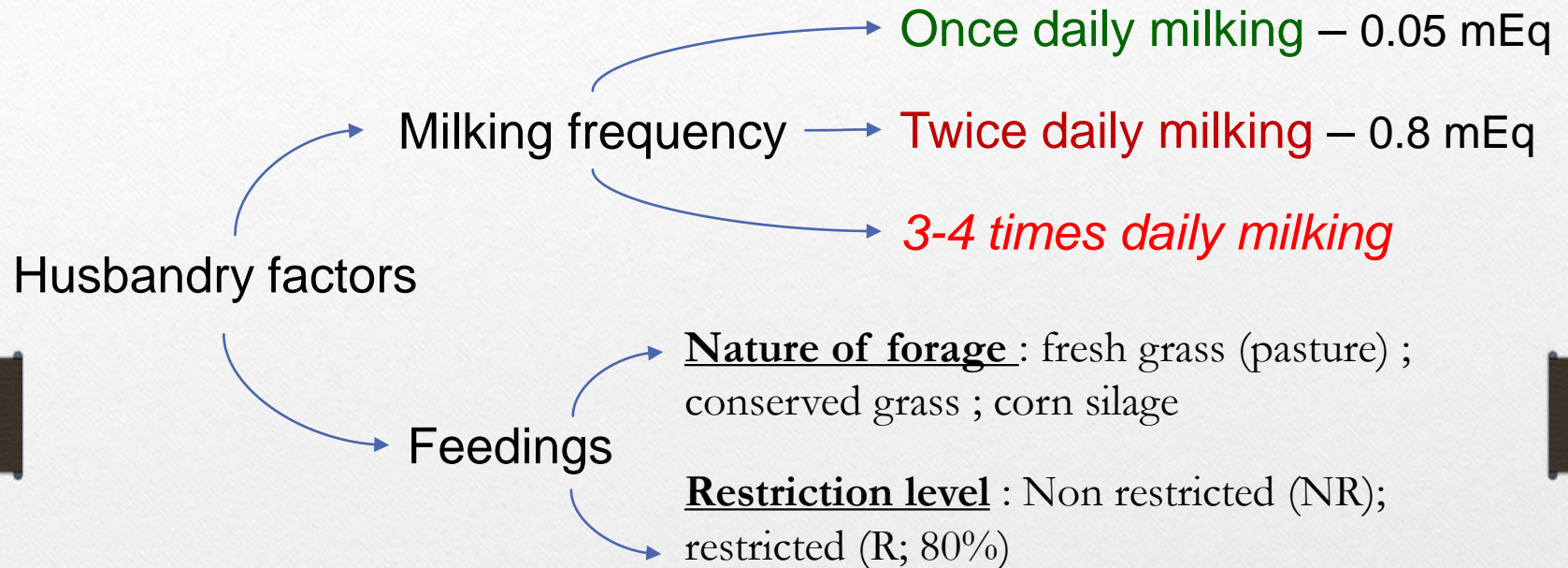
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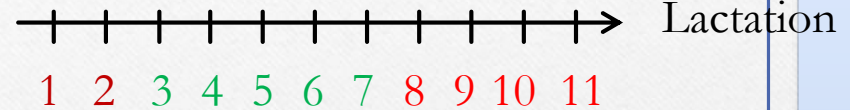


| | Pasture NR | Cons. grass NR | Cons. grass R | Corn silage NR | Corn silage R |
|---------|---------------|-------------------|------------------|-------------------|------------------|
| SL, mEq | 0.19d | 0.40c | 0.80a | 0.71b | 0.80a |

AT A ZOOTECHNICAL LEVEL



Inherent factors



Husbandry factors

Milking frequency : 1 x/j - 2 x/j

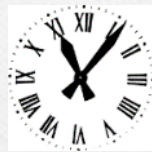
Feedings :

pasture – conserved grass – corn silage (?)

Non restricted – restricted

Morning

Evening



Milking time

Susceptible

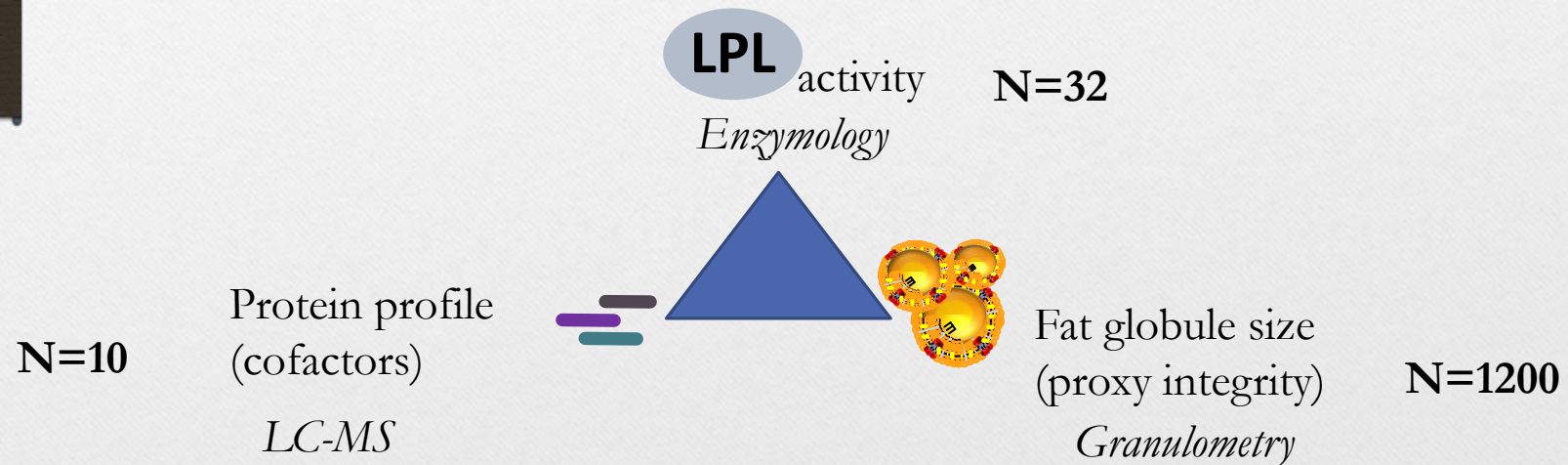
Non – Susceptible



Breed Genetics

AT A BIOCHEMICAL LEVEL

- Milk traits :
No correlation between SL and fat content, protein content, lactose content, SCS.
- Enzymatic system



AT A BIOCHEMICAL LEVEL

- Milk traits :

No correlation between SL and fat content, protein content, lactose content, SCS.

- Enzymatic system

- No correlation between LPL activity in milk and SL
→ total LPL quantity is not a limiting factor of the enzymatic triangle
- Small correlation between MFG size and SL
→ MFG size is not a good proxy of MFG integrity
- Interesting results about milk protein profile !



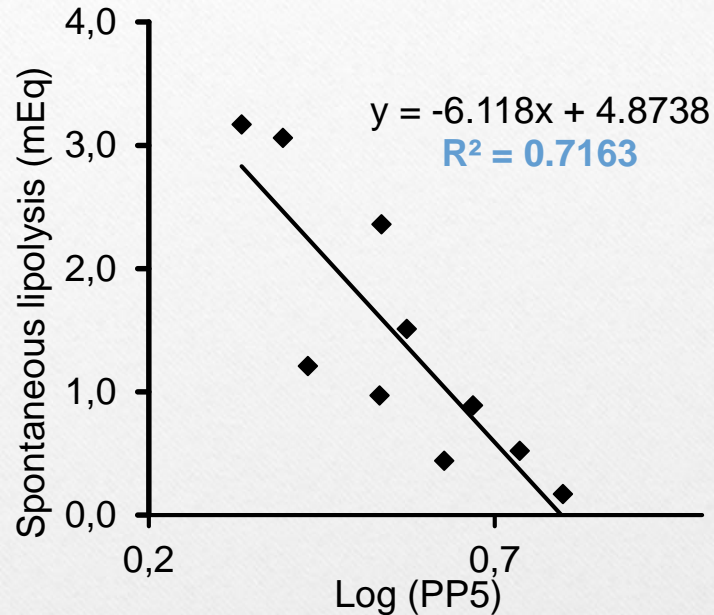
AT A BIOCHEMICAL LEVEL

- 13 proteins / protein fragments detected by LCMS

- β -CN
- α s1-CN
- α s2-CN
- κ -CN
- κ -glyco-CN
- β -LG
- α -LA
- BSA
- Immunoglobulin G1, G2, G3
- PP5
- PP8s



AT A BIOCHEMICAL LEVEL



- Negative correlation between Spontaneous lipolysis and PP5
→ PP5 inhibitor of SL ?

| | Corn silage | Conserved Grass |
|--------------------|-------------|-----------------|
| %PP5 evening milks | 0,86b | 2,76a |

- %PP5 higher with conserved grass → One of the explanation of our result at farm level.

TO BE CONTINUED ...

- Spontaneous AND induced lipolysis on Cows, Goats, Ewes
- Work packages on :
 - **Genetics** – heritability of lipolysis ? – PhenoFinLait database
 - **Husbandry factors** – feeding and milking time
 - **Milking material**
 - **Biochemical mechanisms** – multi-omics, miRNA, better evaluation of MFGM integrity
 - Impact on **dairy products** (cheese)



**THANK YOU FOR YOUR ATTENTION
AND
THANK TO :**



FRENCH ASSOCIATION OF ANIMAL PRODUCTION



CATHERINE HURTAUD – JEAN-LOUIS PEYRAUD
MARIE PIERRE JACQUEROUD



ANNE FERLAY ; GUY MIRANDA ; PATRICE MARTIN ; LUC
DELABY ; JOCELYNE FLAMENT ; CLEMENTINE CHARTON

EXPERIMENTAL FARMS : PIN AU HARAS & MEJUSSEAUME

TECHNICAL TEAMS OF UMR PEGASE AND UMR H

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