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Relationship Between Lactoferrin, Minerals, and Somatic Cells in Bovine Milk

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Introduction

- **Mastitis** is the most costly disease
- Resistance to mastitis
- Collecting the mastitis information is expensive

➔ **Need to use some indicators**

Introduction

- *Current indicator* : Somatic Cell Count (SCC)
  → **Somatic Cell Score** (SCS)

- *Potential indicator*: **Lactoferrin** content
  - Glycoprotein presents naturally in milk
  - Increased content if mastitis (Kutila et al., 2004)
  - Genetic variability of lactoferrin exists (Soyeurt et al., 2007)

→ Interest to study the lactoferrin content

Introduction

- *Potential indicator*: **Minerals**

mg/L of milk	Healthy milk	Milk with high SCC
Na	570	1050 ↑
Ca	1200	400 ↓

Harmon (1974)

  - The variations of Ca and Na in milk could be indicators of mastitis (Waldner et al., 2001)

➔ Interest to study the mineral contents

General Objective

- Aims of this study:
  - Predict some indicators of mastitis in bovine milk using Mid-Infrared (MIR) Spectrometry
  - Study the genetic variability of minerals
  - Study the relationships among potential mastitis indicator traits as lactoferrin content, concentrations of major minerals in milk (Ca and P), and Somatic Cell Score (SCS)

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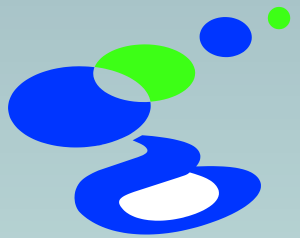
Prediction by MIR



- Regular analysis: Fast but expensive
  - Lactoferrin: ELISA
  - Minerals: Inductively Coupled Plasma Atomic Emission Spectrometry: ICP-AES
- Mid-Infrared (MIR) spectrometry:
  - Fast and cheap
  - Major contents (e.g., %fat, %protein, %lactose)
  - Minor contents (e.g., %fatty acids)

Prediction by MIR

- Calibration set:
  - *Selection of samples*: Principal Components Approach (PCA) on 1,069 samples
  - *Minerals*: 57 milk samples analyzed by ICP-AES
    - Soyeurt et al., ICAR 2008
  - *Lactoferrin*: 68 milk samples analyzed by ELISA
    - Soyeurt et al., JDS 2007
- Partial Least Squares (PLS) regressions
- Repeatability file

Prediction by MIR

- Results:

	N	Mean	SD	SECV	R^2cv	RPD
Ca	57	1251.58	157.44	70.85	**0.80**	**2.22**
P	57	1071.02	107.03	49.73	**0.79**	**2.15**
Lacto	69	256.66	206.44	112.29	**0.71**	**1.84**

SD= Standard deviation; SECV= Standard error of cross-validation; R^2cv = cross-validation coefficient of determination; RPD = the ratio of SD to SECV

- If RPD > 2, good indicator

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Genetic Variability of Minerals

- Data set:
  - 26,086 spectra (March 2005 – December 2007)
  - 5,502 cows belonging to 98 herds
  - Major dairy breeds (92.51%):
    - Brown Swiss (1.26%)
    - Dual purpose Belgian Blue (3.70%)
    - Holstein (70.88%)
    - Jersey (1.65%)
    - Montbeliarde (4.91%)
    - Normande (7.03%)
    - Red and White (3.08%)

Genetic Variability of Minerals

- Multi-trait animal test-day mixed model:
  - Fixed effects:
    - Herd x date of test
    - Lactation number (1, 2, 3, 4 or 5)
    - 20 classes of days in milk
    - Month of test
    - Year of test
    - Month of calving x year of calving
    - Regressions on breed composition
  - Random effects:
    - Permanent environment
    - Additive genetic effect
    - Residuals
- (Co)Variances estimated by REML (Misztal, 2008)

Genetic Variability of Minerals

	Heritability	SE
Milk (kg/day)	0.15	0.017
%Fat (g/100 g of milk)	0.34	0.021
%Prot (g/100 g of milk)	0.39	0.023
Ca (mg/L of milk)	**0.42**	**0.023**
P (mg/L of milk)	**0.47**	**0.025**
SCS	0.11	0.016
Lactoferrin (mg/L of milk)	0.28	0.019

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Relationships

Phenotypic correlations (above the diagonal) and genetic correlations (below the diagonal)

	Milk	Fat	Prot	Ca	P	SCS	Lacto
Milk		-0.24	-0.32	**-0.21**	-0.15	-0.14	-0.38
%fat	-0.20		0.44	**0.53**	0.36	0.05	0.34
%protein	-0.30	0.49		**0.55**	0.67	0.09	0.55
Ca	**-0.13**	**0.47**	**0.42**		0.53	0.00	0.34
P	-0.11	0.50	0.72	0.59		-0.02	0.15
SCS	-0.13	-0.15	-0.01	-0.10	-0.16		0.29
Lacto	-0.44	0.27	0.53	0.12	0.01	0.28	

Correlations between Ca and %protein was expected higher

Average 65% of Ca are bonded to the casein (Guéguen and Pointillart, 2000)

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Explaining by the structure of casein (Guéguen and Pointillart, 2000) and the membrane of fat globule (Danthine, 2000)

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Harmon (1974) observed a decrease of Ca when SCS increases

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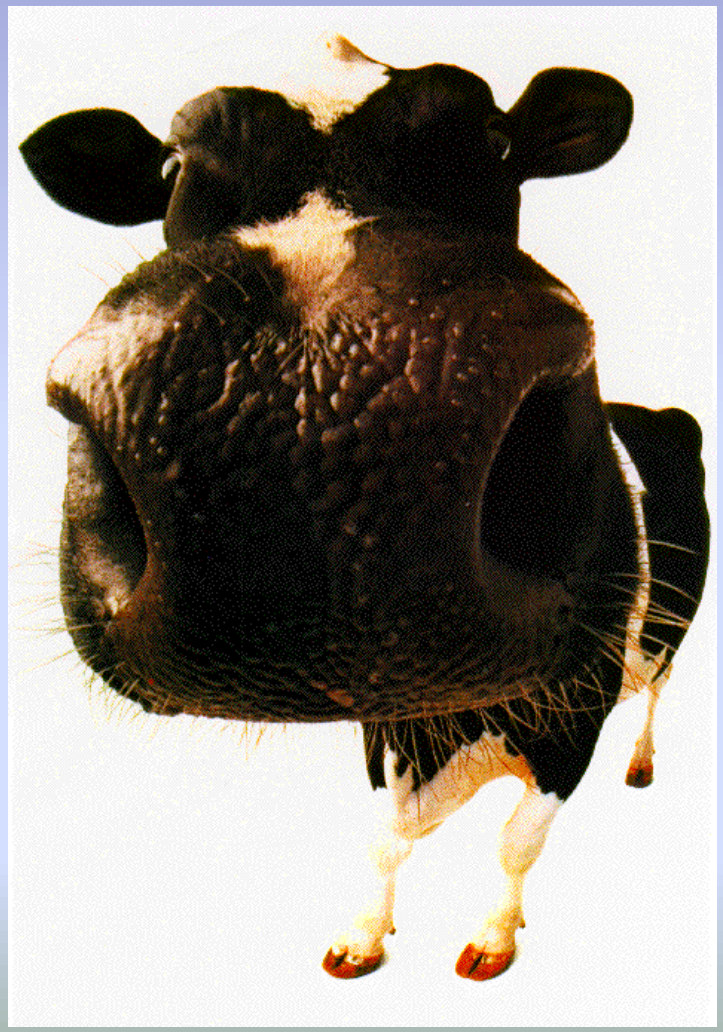
Conclusions

- Potential estimation of Ca and P by MIR spectrometry (ICAR, 2008)
- Genetic variability of minerals exists:
  - Interest to increase the Ca content in milk because feeding has a limited impact
- Correlations between Ca or P and the content of lactoferrin or SCS were low
  - Study the relationship between the changes in the contents of Ca and P and the presence of mastitis

Thank you for your attention



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Walloon Breeding Association

Milk Committee of Battice

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