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Potential Estimation of Minerals Content in Cow Milk Using Mid-Infrared Spectrometry

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Introduction

- Interest for human and animal health:
  - Ca : osteoporosis, milk fever
  - Na : milk fever, alkalosis, indicator of mastitis?
- Dairy products with high Ca content are commercialized to prevent osteoporosis (e.g., Belgium,…)

Introduction

- Regular analysis
- Inductively Coupled Plasma Atomic Emission Spectrometry: ICP-AES
  - Fast
  - Expensive
- Previous studies on the measurement of milk components by Mid-Infrared (MIR) Spectrometry:
  - Fast and cheap
  - %fat, %protein, %fatty acids, %lactose, urea,…

General Objective

- Estimate the contents of the major minerals in cow milk (Ca, Na, and P) by MIR spectrometry

Milk Samples

- 1,609 milk samples :
  - March 2005 and May 2006
  - 478 cows in 8 herds belonging to 6 dairy breeds:
    - dual purpose Belgian Blue, Holstein Friesian, Jersey, Montbeliarde, Normande, and non-Holstein Meuse-Rhine-Yssel type Red and White
- 2 samples:
  - MilkoScan FT6000 during the Walloon milk recording
  - Conserved at -26°C

Calibration

- Selection of samples :
  - Principal Components Approach (PCA)
  - 70 selected samples
    - 9 samples with bad conservation
    - 4 outliers
- Reference analysis:
  - ICP-AES without mineralization

Calibration

- Equations:
  - 57 samples
  - Partial Least Squares (PLS) regressions
  - Repeatability file:
    - Walloon part of Belgium
    - Luxembourg
  - Accuracy: Full cross-validation

Results

	N	Mean	SD	SECV	R^2cv	RPD
Na	57	431.39	102.10	57.31	0.69	1.78
Ca	57	1251.58	157.44	66.98	**0.82**	**2.35**
P	57	1071.02	107.03	51.87	**0.77**	**2.06**

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
- Good prediction of Ca and P (high contents)

Real MIR absorbance?

	Ca	P	%fat	%prot	lactose	urea
Na (mg/l of milk)	-0.25	-0.08	-0.49	0.33	-0.76	0.46
Ca (mg/l of milk)		0.58	0.52	0.21	0.19	-0.37
P (mg/l of milk)			0.38	0.56	-0.02	0.14
%fat (g/dl of milk)				0.29	-0.41	0.39
%prot (g/dl of milk)					0.19	-0.12
Lactose (g/dl of milk)						-0.33

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Rcv = 0.90

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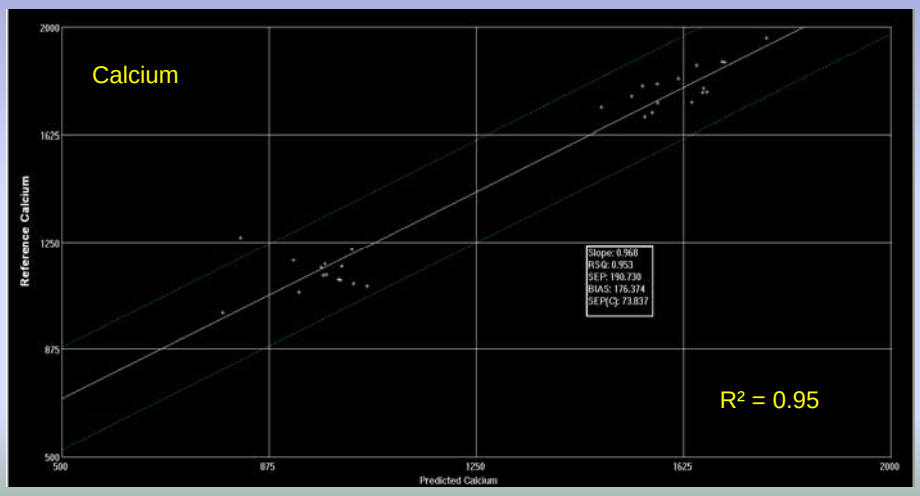
Lactose (g/dl of milk)						-0.33

Rcv = 0.88

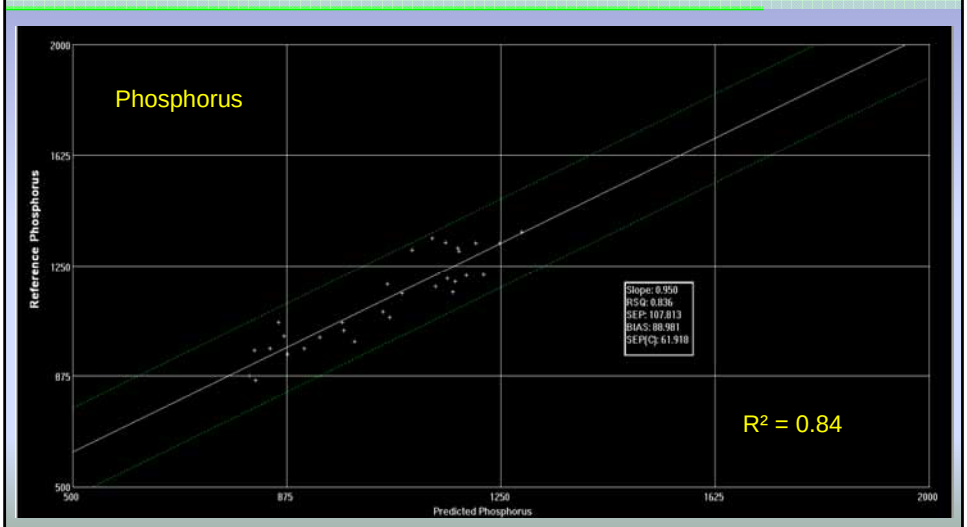
Validation

- Validation:
  - Internal validation:
    - cross-validation
  - External validation:
    - samples not used for the calibration procedure
- 30 milk samples

Validation



Validation



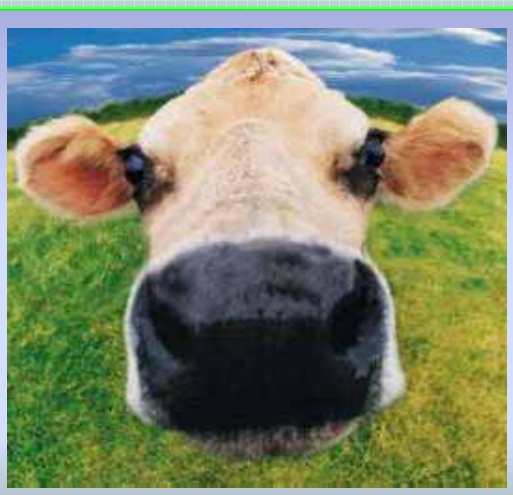
Conclusion

- Potential estimation of Ca and P directly on bovine milk
- Prospects for the calibration:
  - Increasing the samples used for the calibration
  - Executing a larger external validation

Prospects

- Genetic variability of minerals
  - Prevent osteoporosis
    - Feeding has a low influence on Ca content
    - Heritability (26,086 data):
      - Calcium: 0.42
      - Phosphorus: 0.47
  - Prevent milk fever?
- Indicators of mastitis??

Thank you for your attention



Acknowledgments

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