Comparison of milk composition and somatic cell count estimates from automatic milking systems sensors and milk recording laboratory

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valacta

Introduction

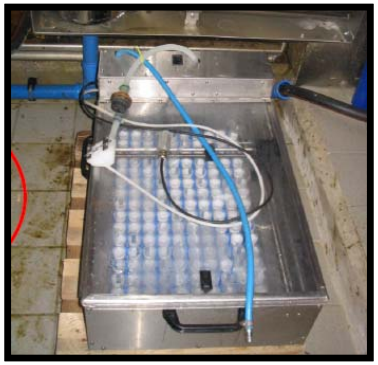
- >11% of milk recorded herds in Canada use AMS and are increasing rapidly
- Many new installations include sensors for components and / or SCC
- Sampling for MR in AMS can be challenging
- Farmers are requesting that sensors data be considered
- Accuracy needs to be characterized for adequate use for:
  - Management
  - Performance recognition programs / awards
  - Genetic evaluations

Objective

- The aim of this study was to characterise and compare estimates from AMS sensors and milk-recording laboratory among the lactation.

Materials and methods

- 10 herds with Lely AMS (MQC sensors)
  - Samples taken over a 24-h period
  - Laboratory samples were 24-hr weighted average for comparison with the AMS estimation *(average of the 5 last milkings)*
  - Samples were analysed in the Valacta laboratory for milk components and SCC (CombiFoss FT+, Foss, Hillerod, DK)
- 5 herds with De Laval VMS with OCC sensors

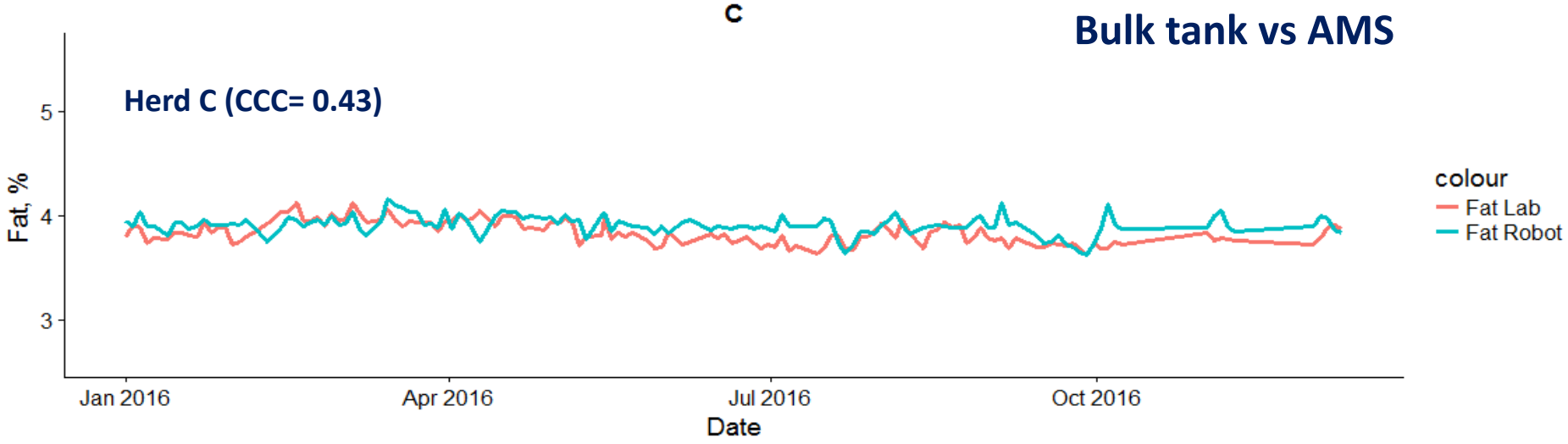


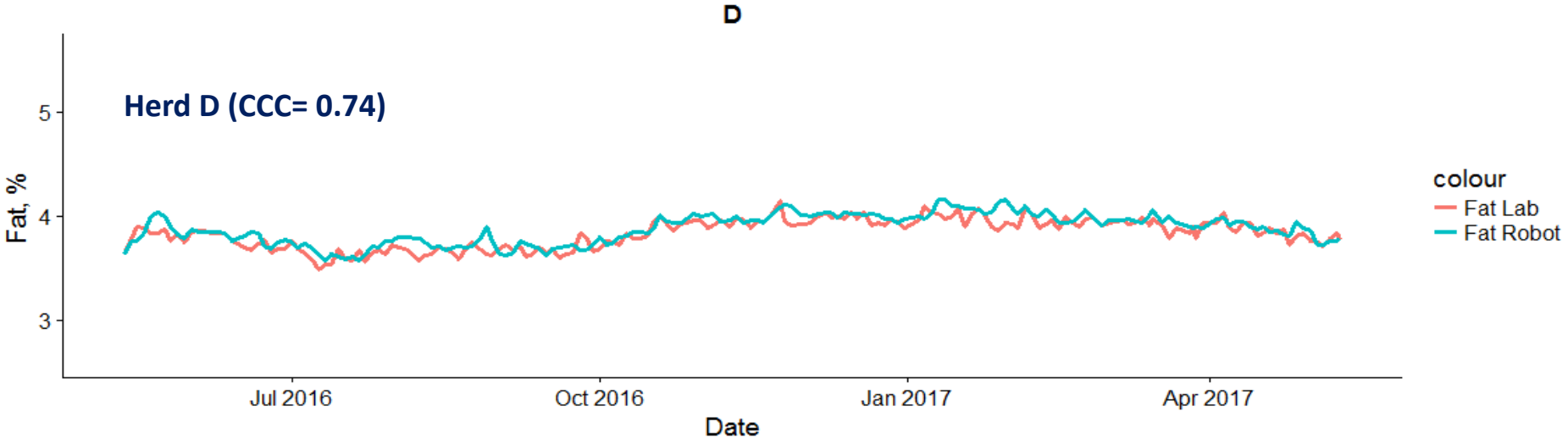
Materials and methods

- Comparisons of fat, protein, lactose and SCC from the AMS and the MR laboratory were done among categories of DIM:
  - **DIM 1**: 5 to 100 **DIM 2**: 101 to 200 **DIM 3**: >201
- Data from the AMS was exported in Microsoft Excel and then to R program (R Development Core Team, 2017) where all analysis were done
- Differences were calculated as: **AMS - laboratory results**
- Data analyses included:
  - Mean absolute error (MAE)
  - Concordance correlation coefficient (CCC) and Bland Altman analysis
  - LSMEANS (Tukey)

Results

Bulk tank vs AMS





Results

Mean differences and SD of milk components for all herds and the three categories of DIM generated by the Lely AMS and the MR laboratory

Item	Fat (%)				Protein (%)				Lactose (%)			
	Lab	AMS	Difference	MAE[1]	Lab	AMS	Difference	MAE	Lab	AMS[2]	Difference	MAE
All	3.81 (0.55)	3.76 (0.57)	-0.05 (0.50)	0.38	3.19 (0.28)	3.19 (0.21)	-0.001 (0.23)	0.18	4.68 (0.16)	4.65[2] (0.11)	-0.04 (0.1)	0.09
DIM1	3.68 (0.50)	3.47 (0.50)	-0.21 (0.51)	0.43	3.04 (0.25)	3.15 (0.21)	0.12 (0.18)	0.18	4.7 0 (0.15)	4.64 (0.10)	0.07 (0.10)	0.10
DIM2	3.71 (0.48)	3.71 (0.50)	0.01 (0.46)	0.35	3.18 (0.22)	3.18 (0.21)	-0.0005 (0.21)	0.17	4.69 (0.15)	4.64 (0.12)	-0.06 (0.09)	0.08
DIM3	4.08 (0.58)	4.19 (0.48)	0.10 (0.46)	0.35	3.41 (0.24)	3.26 (0.21)	-0.15 (0.20)	0.20	4.64 (0.17)	4.67 (0.11)	0.01 (0.10)	0.08

[1]Means absolute error

[2]Data available only for seven farms

Results

Mean differences and SD of milk components yield for all herds and the three categories of DIM generated by the Lely AMS and the MR laboratory

Item	Fat yield (kg/d)				Protein yield (kg/d)			
	Lab	AMS	Difference	MAE[1]	Lab	AMS	Difference	MAE
All	1.67 (0.40)	1.63 (0.40)	-0.04 (0.23)	0.17	1.39 (0.30)	1.40 (0.33)	0.01 (0.10)	0.08
DIM1	1.76 (0.44)	1.64 (0.44)	-0.12 (0.25)	0.22	1.43 (0.34)	1.49 (0.36)	0.06 (0.09)	0.08
DIM2	1.65 (0.38)	1.63 (0.38)	-0.02 (0.20)	0.16	1.39 (0.26)	1.40 (0.28)	0.00 (0.10)	0.07
DIM3	1.60 (0.33)	1.63 (0.36)	0.04 (0.18)	0.13	1.33 (0.28)	1.27 (0.28)	-0.06 (0.08)	0.08

[1]Means absolute error

Results

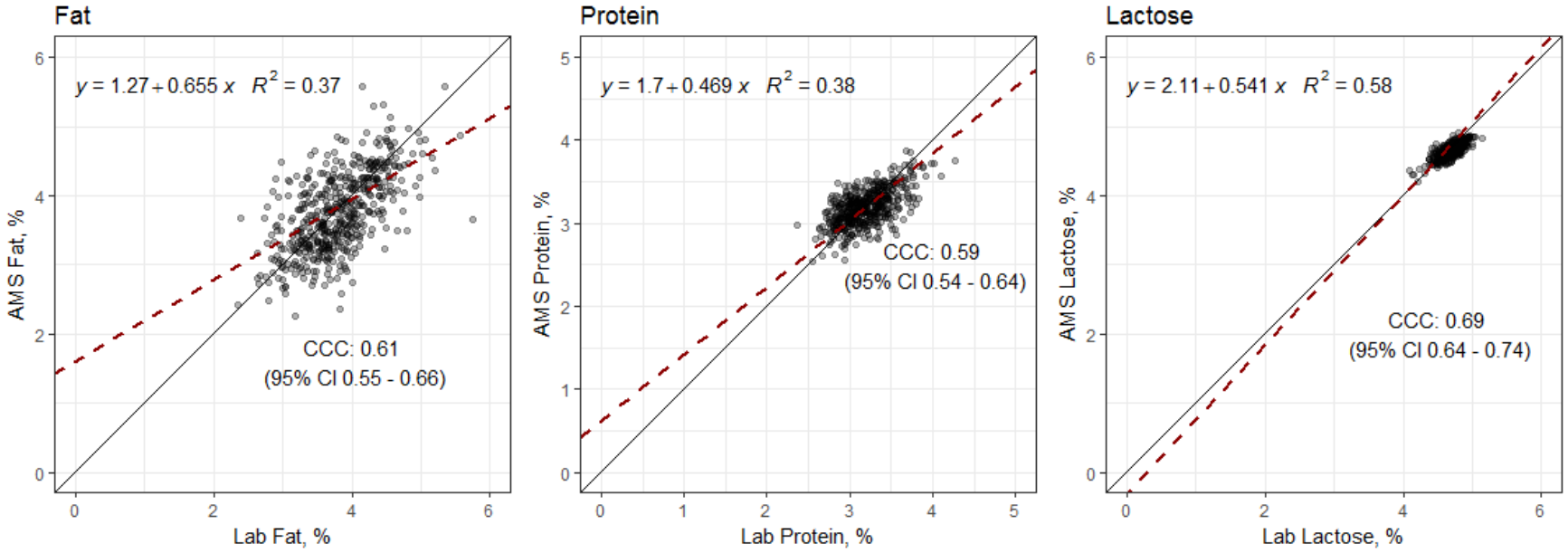
Mean differences and SD of SCC and linear score for all the herds and the three categories of DIM generated by the Lely AMS and the MR laboratory

Item	SCC (cells/mL)[1]				Linear score			
	Lab	AMS[2]	Difference	MAE[3]	Lab	AMS	Difference	MAE
All	133 (351)	71 (145)	-61.21 (263)	101	2,08 (1,69)	2,07 (0,94)	-0,01 (1,60)	1.34
DIM1	115 (357)	79.9 (226)	-36.1 (172)	77.3	1.87 (1.61)	2.13 (0.89)	0.24 (1.50)	1.25
DIM2	155 (432)	70.8 (70.6)	-80.9 (387)	127.4	2.08 (1.76)	2.14 (0.96)	0.10 (1.67)	1.43
DIM3	135 (223)	64.4 (63.0)	-73.9 (194)	103.6	2.34 (1.68)	1.99 (0.99)	-0.38 (1.62)	1.39

[1]Geometric mean of the last three milkings (x1000)
[2]Data available only for six farms
[3]Means absolute error

Results

CCC (All herds)



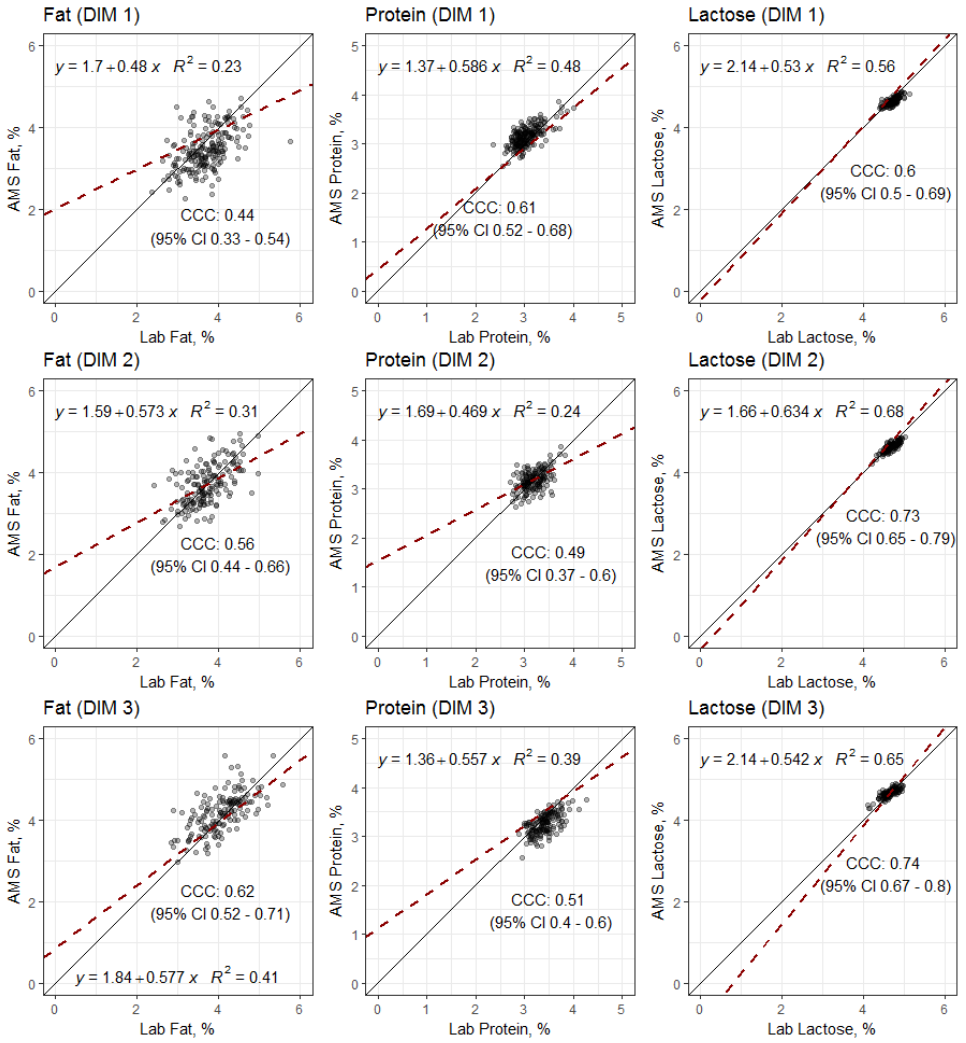
Bland Altman analysis indicate that fat percentage had the highest mean bias followed by lactose and protein (0.05, 0.04 and 0.001, respectively)

Results

CCC categories of DIM

Mean bias (Bland Altman analysis)

Item	Fat (%)	Protein (%)	Lactose (%)
DIM 1	0.21	-0.12	0.07
DIM2	-0.01	0.0005	0.06
DIM 3	-0.10	0.15	-0.01



Results

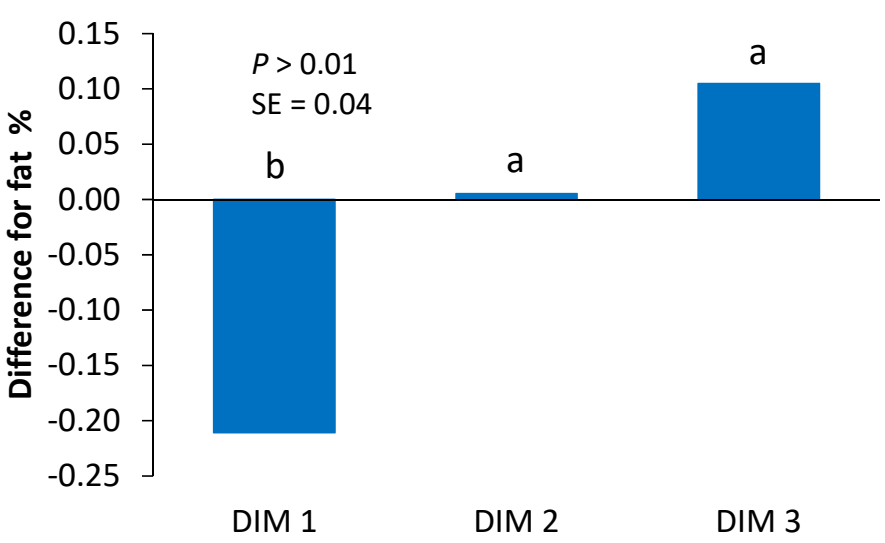
Categories of DIM

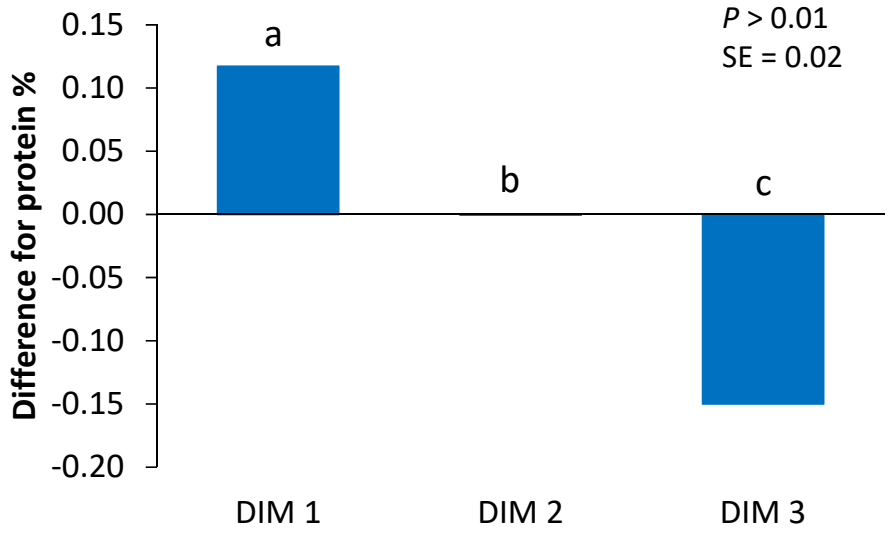
Categories of DIM:

DIM 1 : DIM between 5 and 100

DIM 2 : DIM between 101 and 200

DIM 3: >201 DIM

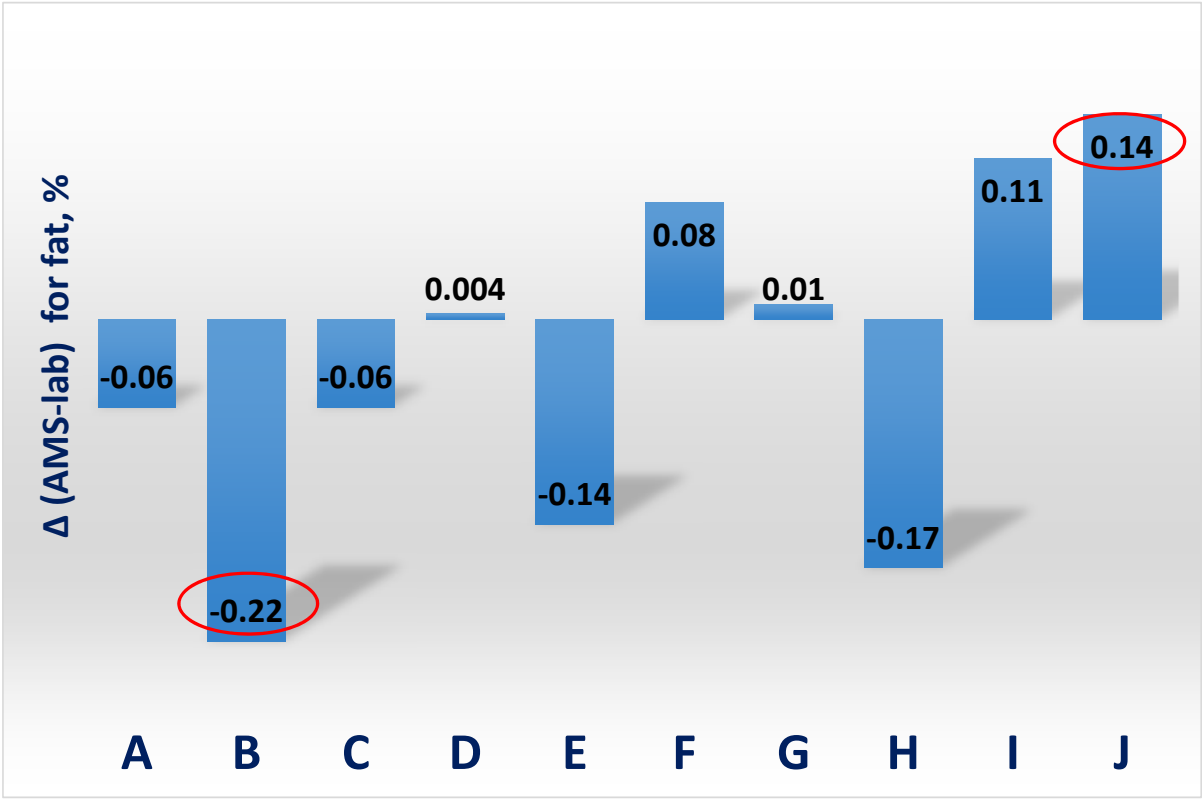




Results

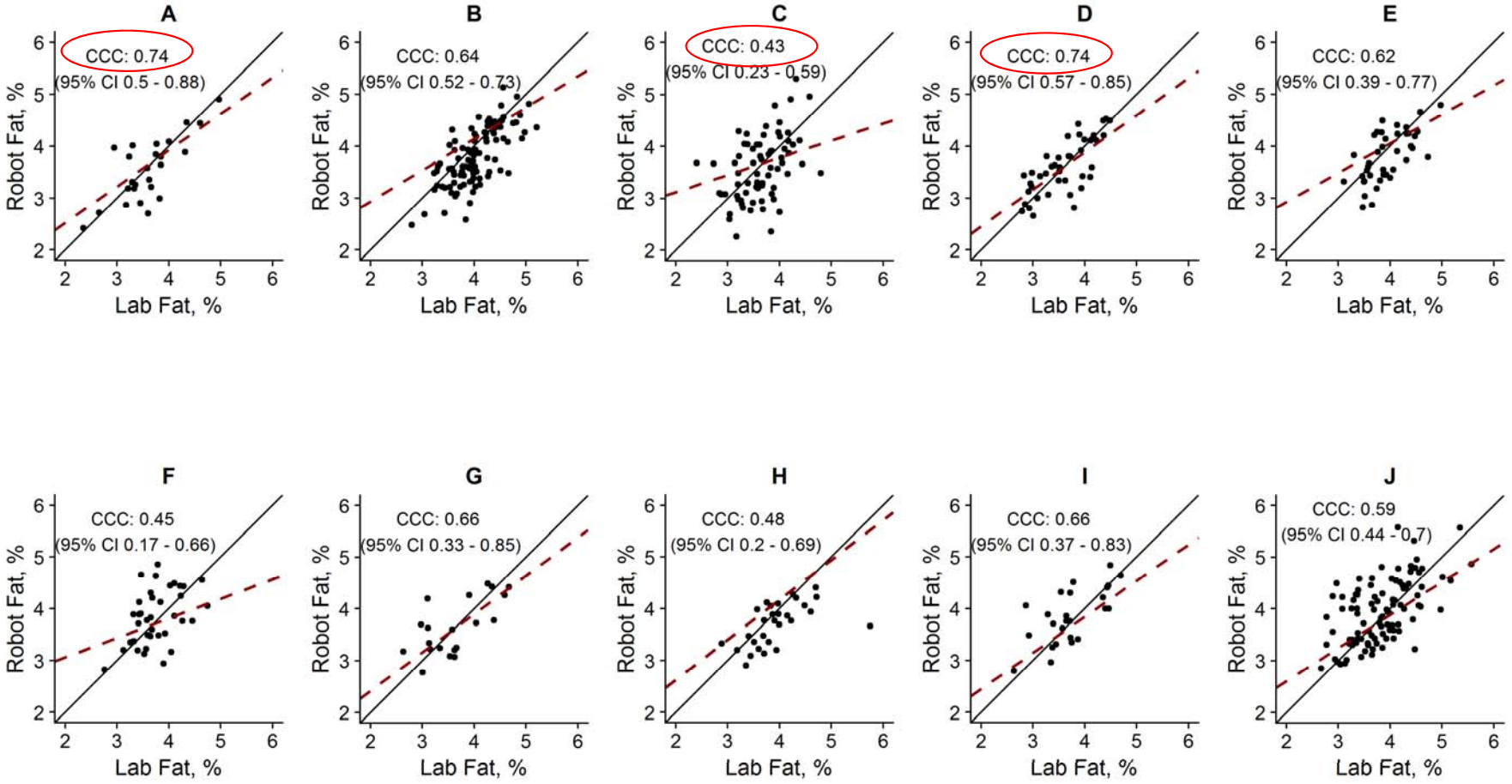
By herd

Differences among herds were larger for fat than for protein percentage (MAE = 0.47 to 0.28%)



Results

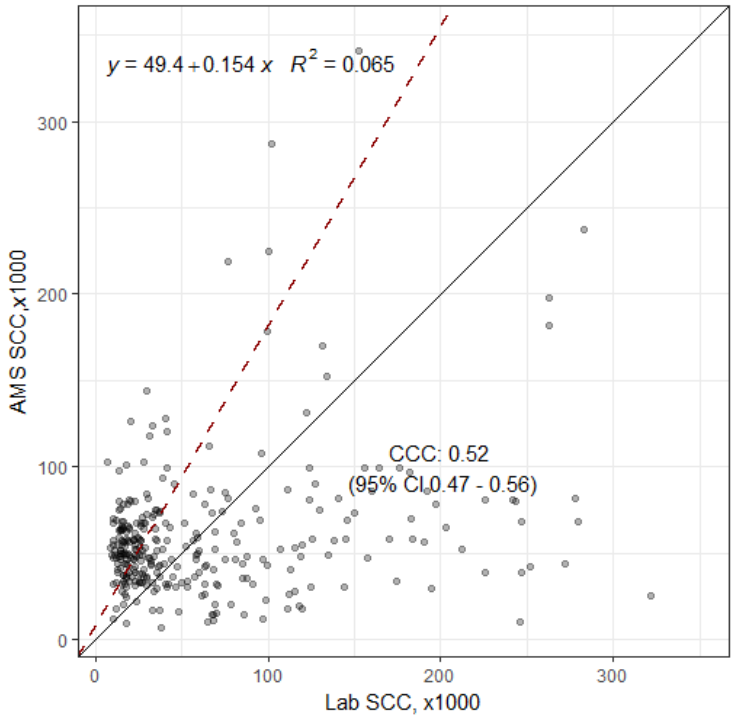
CCC between milk fat percentages from the AMS sensors and the laboratory analysis of the 10 farms



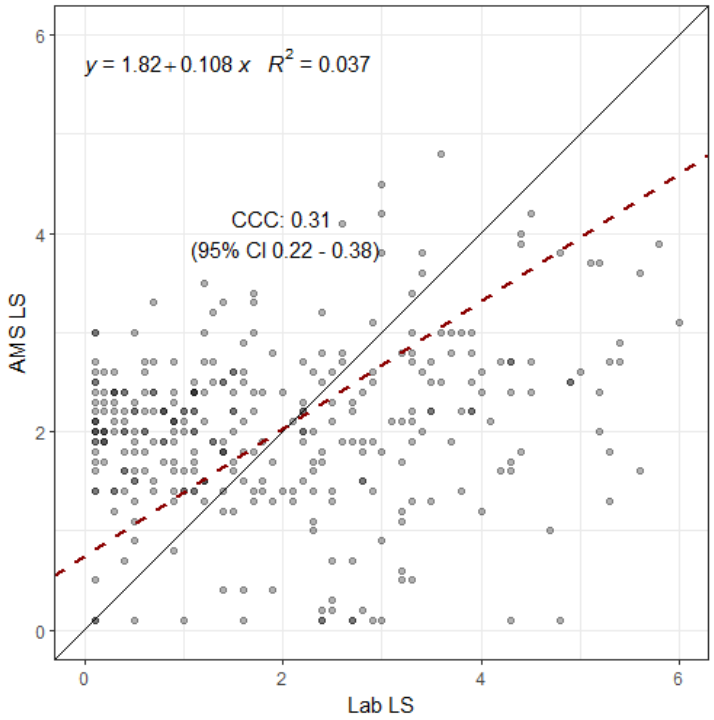
Results

CCC (All herds)

Somatic cell count

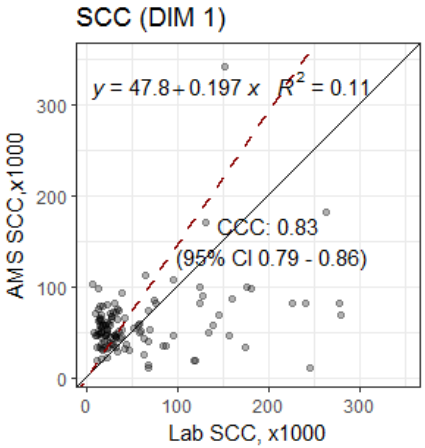


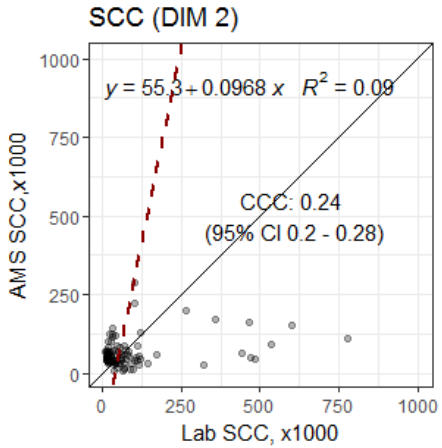
Linear score

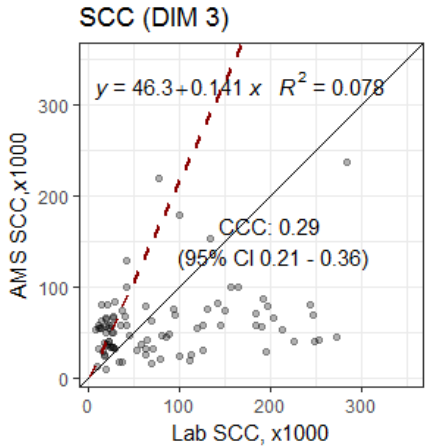


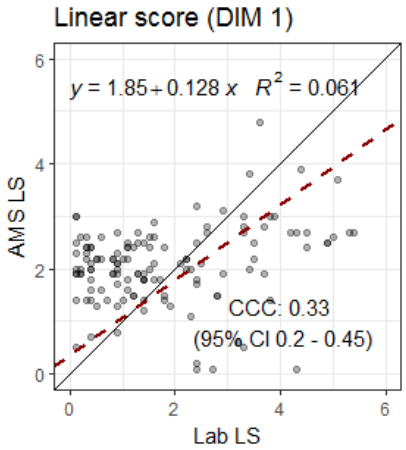
Results

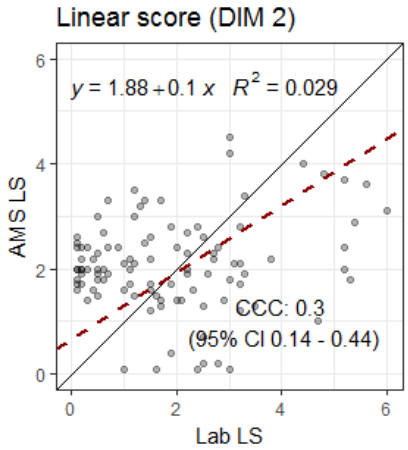
CCC categories of DIM

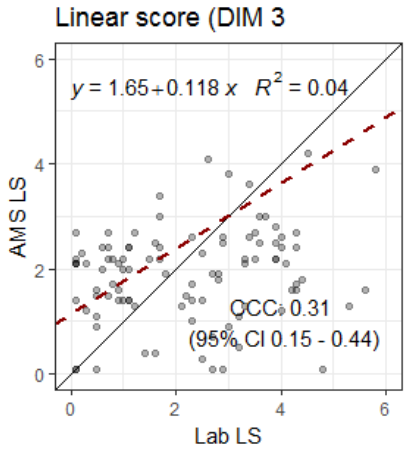












Discussion

Calibration

- One hypothesis to explain the large inter-herd variations may be the way producers calibrate the sensors.
  - Calibration of the Lely AMS sensors can be done in two ways:
    1) At the cow level: using the results of the DHI
    2) At the herd level: using the results of the bulk tank
- Units of the two methods are different in Canada
  - DHI is in kg/100kg or percentage
  - Bulk tank is in kg/hl or kg/100 litres.
    - Systematic bias of approx. 3% (kg/hl ≈ kg/100 kg x 1.03)
    - Plus, an additional bias of approx. 0.98 % for lactose (bulk tank include lactose and other solids.
- Frequency at which the calibration is made ????

Discussion

Globule size

- Differences among categories of DIM may be affected by fat globule size
  - AMS sensors use fat globule size to *determine* milk composition.
  - Milk fat globule size is bigger at the beginning of the lactation and then decrease thereafter (Wiking et al., 2004, Fleming et al., 2017).
  - Other factors that can affect fat globule size are genetic, diet, season and milk intervals (Logan et al., 2014, Dutreuil et al., 2016).

Conclusions

- Results suggest that accuracy of the estimates of milk composition may differ according to the stage of lactation.
- Future research to better understand the impact of the calibration frequency and protocol
- Evaluate value for genetic evaluation and other usages
- Establish routine data quality checks

Acknowledgements

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