SP-P5: Estimating daily yield and content of major fatty acids from single milking

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Context

Reducing the frequency of milk recording and the number of recorded samples per test-day could be a solution in order to reduce costs of official milk recording. Numerous studies aim to estimate daily yield of milk, protein, and fat from single milking (e.g. Delorenzo and Wiggans 1986 ; Liu et al., 2000; Berry et al., 2006;). Currently, all milk recording organizations develop an alternate milk recording scheme **but this involves a loss of accuracy in the predicting daily yields**. Further, the milking interval (MI) effect used in previous studies to estimate the daily yields of common production traits, are not often available and sometimes unreliable.

Objective 1

➢ To develop and to propose **an useful, robust and simple method for estimating accurate daily yields of milk, protein and fat from single milking without using the MI in the model.**

➢ Hypothesis: the MI can be reflected by the changes of milk yield and composition.

Objective 2

➢ No model is currently available for milk fatty acids (FA)

→ To propose a similar method for major FA such as **saturated** (SFA), **mono-unsaturated** (MUFA), **unsaturated** (UFA), **medium-chain** (MCFA) and **long-chain fatty acids** (LCFA) **and C18:1 cis9**

Materials and Methods

Database

- ***Modeling database***: 79,971 milk samples collected in Luxembourg between October 2007 and August 2013 by CONVIS s.c..
- ***Test database***: 687 representative milk samples collected in Luxembourg between February 2012 and April 2012 by CONVIS s.c..
- ***External validation database***: 22,526 milk samples collected in Wallonia between October 2007 and August 2012.
- These milk samples were analyzed by MIR spectrometry by a Foss MilkoScan FT6000 (Hillerod, Denmark)

Prediction of FA content

- **FA content (g/dl of milk) were estimated using specific MIR calibration equations developed by the Walloon Research Centre.**
- Only FA **having** a RPD parameter **for the calibration equation** (ratio of the standard deviation of reference fatty acid values to the standard error of cross-validation) greater than 5 were studied.

Estimating daily content from single milking

- Study of correlation values → Development of practical and useful **regressions**
- **Fixed effects**: milk yield, protein and fat contents in each milking, lactation number, days in milk, season of calving, season of test, etc. (96 classes)
- Comparison **with the reference method proposed by Liu et al.** (2000).

Validation of developed models

- Use of a test database and a validation database
- SAS procedure: PROC GMSELECT.
- Studied parameters: **Ry,ŷ, Mean error, σŷ and RMSE**

Results and discussion

Table 1. **Descriptive statistics of the analyzed data (g/dl of milk) (N=79,971).**

Variable		*Mean*	*SD*	*Min.*	*Max.*
Milk (kg/day)	AM	12.79	4.27	1.20	37.30
	PM	13.57	4.41	1.20	39.20
	Daily	26.36	8.33	2.40	72.80
FAT	AM	4.11	0.71	1.01	7.23
	PM	4.55	0.78	1.12	8.00
	Daily	4.34	0.75	1.07	7.67
SAT	AM	2.76	0.56	0.51	6.95
	PM	2.95	0.60	0.54	7.44
	Daily	2.86	0.58	0.53	7.21
MONO	AM	1.15	0.24	0.29	3.84
	PM	1.36	0.29	0.35	4.56
	Daily	1.26	0.27	0.32	4.22
INSAT	AM	1.34	0.27	0.37	4.25
	PM	1.59	0.32	0.44	5.02
	Daily	1.47	0.29	0.40	4.66
SCFA	AM	0.38	0.08	0.10	1.02
	PM	0.40	0.08	0.10	1.08
	Daily	0.39	0.08	0.10	1.06
MCFA	AM	2.16	0.47	0.06	5.77
	PM	2.29	0.50	0.06	6.11
	Daily	2.22	0.49	0.06	5.96
LCFA	AM	1.58	0.35	0.31	5.47
	PM	1.87	0.42	0.37	6.48
	Daily	1.73	0.39	0.34	6.01
C18:1 cis9	AM	0.75	0.19	0.07	2.97
	PM	0.91	0.23	0.09	3.59
	Daily	0.83	0.21	0.08	3.30

Table 2. **Correlation values (r) among morning (AM), evening (PM), and daily (DM) records for each studied trait expressed in milk (g/dL of milk)**

	AM-PM	AM-DM	PM-DM
Milk (L)	90.4	97.2	97.9
FAT	78.7	93.1	95.8
SFA	58.1	87.5	89.8
MUFA	63.7	88.3	92.1
UFA	63.3	88.3	91.9
SCFA	57.9	87.0	90.1
MCFA	60.8	88.3	90.6
LCFA	63.4	88.2	92.1
C18:1 cis9	65.8	88.9	92.7

Table 3. Correlation (R) **and root mean squared errors** (√MSE) for each studied traits between calculated and estimated **contents** based on morning and evening **milkings**.

	AM				*PM*			
	Ry,ŷ	**Mean error**	**σŷ**	**RMSE**	**Ry,ŷ**	**Mean error**	**σŷ**	**RMSE**
MILK	98.3	0.11	8.48	2.25	98.5	-1.20	8.22	2.38
FAT	98.1	0.98	35.1	16.06	98.6	-3.32	35.2	12.47
SFA	97.9	0.89	24.84	11.39	98.7	-1.98	24.74	9.05
MUFA	98.3	0.14	10.5	5.13	98.9	-0.93	10.6	3.82
UFA	96.9	-0.05	11.88	5.81	98.9	-1.10	12.00	4.36
SCFA	98.6	0.07	3.54	1.59	98.8	-0.26	3.51	1.30
MCFA	98.3	0.99	19.59	8.91	98.7	-1.79	19.82	7.05
LCFA	98.4	-0.03	15.12	7.33	98.9	-1.03	15.14	5.58
C18:1 cis9	98.5	-0.12	8.25	3.87	99.0	-0.30	9.99	2.78

- **MI effect could be replaced by a combination of dairy traits easily recorder by the milk recording organizations** such as milk yield, fat and protein contents, classes of lactation stage, month of test, and month of calving
- **Comparison of Model 8 (M8) and Liu's model** (Liu et al., 2008) when Liu's model is applied on the used database → **similar results**
- **Interesting correlation values** between calculated and estimated contents.
- **Daily estimations based on evening milkings** (**r from 98.5 to 99.0**) **are more accurate than those based on morning milkings** (**r from 96.9 to 98.5**).

Conclusions

- According to the used database, **MI effect can be partially or totally replaced by a combination of available effects**
- Because of their simplicity, **proposed models and required available data are relatively easy to implement**

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