

Mid-Infrared Predictions of Fatty Acids in Bovine Milk: Final Results of the RobustMilk Project

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1. Objective

To estimate the nutritional quality of milk fat in cow milk

Reference analysis : Gas Chromatography is expensive and time consuming
→ Mid-Infrared Spectrometry is a faster, cheaper alternative.

2. Material and methods

Sampling

1,776 milk samples were collected in the Walloon Region of Belgium, Ireland, and Scotland between March 2005 to August 2009. All samples were analyzed using 2 different MilkoScan FT6000 spectrometers.

Reference values

Milk samples were analyzed by gas chromatography

based on a methodology derived from Collomb *et al.* (2000) with a capillary column of 100m length. Fatty acid contents were expressed in milk (g/dl of milk).

Calibration equations

To avoid any problem of baseline drift, a first derivative pre-treatment on spectral data was used.

Multivariate calibration equations were built by using Partial Least Squares regression. A T-outlier test was used to detect potential outliers.

3. Results and discussion

Samples were collated from 6 breeds, 3 geographical areas with different production systems, across seasons resulting in a high variability of milk FA composition observed in the calibration set.

If RPD > 2.4 → Potential use of calibration equations

All studied FA showed a RPD > 2.4 with the exception of C14:1, C16:1*cis*, C18:2, C18:2*cis-9,cis-12*, C18:3*cis-9,cis-12,cis-15*, C18:2*cis-9,trans-11*, and polyunsaturated FA.

The use of mid-infrared spectrometry to quantify the contents of FA in bovine milk has been suggested previously by Belgian and Dutch research teams but with a more limited calibration set.

These results confirmed the ability of the mid-infrared spectrometry to quantify the contents of FA in bovine milk.

Table 1 : Estimated statistical parameters for each calibration equation that characterise concentrations of fatty acid in milk (g/dl of milk)

Constituent (g/dl of milk)	N	Mean	SD	SEC	R ² _c	SECV	R ² _{cv}	RPD
Fat	1604	3.93	0.94	0.025	1.00	0.026	1.00	36.5
C4:0	1643	0.10	0.03	0.009	0.91	0.009	0.90	3.2
C6:0	1649	0.08	0.02	0.005	0.94	0.005	0.94	4.1
C8:0	1631	0.05	0.01	0.003	0.95	0.003	0.95	4.2
C10:0	1636	0.11	0.03	0.008	0.95	0.008	0.94	4.2
C12:0	1619	0.14	0.04	0.011	0.93	0.011	0.93	3.8
C14:0	1644	0.46	0.13	0.030	0.94	0.031	0.94	4.1
C14:1	1623	0.04	0.02	0.007	0.79	0.007	0.77	2.1
C16:0	1630	1.25	0.41	0.071	0.97	0.074	0.97	5.6
C16:1 <i>cis</i>	1628	0.07	0.02	0.011	0.78	0.011	0.76	2.0
C17:0	1594	0.03	0.01	0.003	0.87	0.003	0.86	2.6
C18:0	1626	0.36	0.13	0.046	0.87	0.048	0.86	2.6
C18:1 <i>trans</i>	1619	0.12	0.06	0.022	0.85	0.023	0.84	2.5
C18:1 <i>cis-9</i>	1629	0.69	0.22	0.055	0.94	0.057	0.94	3.9
C18:1 <i>cis</i>	1629	0.74	0.24	0.054	0.95	0.056	0.95	4.3
C18:2	1610	0.09	0.03	0.014	0.73	0.014	0.71	1.9
C18:2 <i>cis-9,cis-12</i>	1603	0.06	0.02	0.010	0.78	0.011	0.77	2.1
C18:3 <i>cis-9,cis-12,cis-15</i>	1618	0.02	0.01	0.004	0.75	0.004	0.73	1.9
C18:2 <i>cis-9,trans-11</i>	1600	0.03	0.02	0.009	0.81	0.009	0.80	2.2
Saturated FA	1635	2.75	0.75	0.060	0.99	0.063	0.99	12.0
Monounsaturated FA	1624	1.01	0.30	0.051	0.97	0.053	0.97	5.7
Polyunsaturated FA	1641	0.16	0.05	0.021	0.82	0.022	0.80	2.2
Unsaturated FA	1631	1.17	0.34	0.058	0.97	0.060	0.97	5.7
Short chain FA	1648	0.36	0.10	0.023	0.95	0.023	0.94	4.2
Medium chain FA	1626	2.11	0.62	0.089	0.98	0.093	0.98	6.7
Long chain FA	1630	1.44	0.44	0.096	0.95	0.100	0.95	4.4

SD = Standard deviation ; SEC = Standard error of calibration ; R²_c = Calibration coefficient of determination ; SECV = Standard error of cross-validation ; R²_{cv} = Cross-validation coefficient of determination ; RPD = Ratio of standard error of cross validation to standard deviation .

4. Conclusion

Mid-infrared spectrometry is used routinely for the milk analysis. Calibration of spectrometers for the FA traits is feasible and could permit the use of these predictions at large scale in programs of milk improvement.

In this context, the RobustMilk project has already started the genetic evaluation of fatty acids in milk with a view the current selection index to appreciate the nutritional quality of milk.



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