Predicting bovine milk fat composition using infrared spectroscopy

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Introduction 1/2

- Fat% is routinely determined by Infrared (FTIR)
- No info is available on fat composition
- This might be important for human health
- Might provide management info on cows
- Fat composition can be determined by Gas Chromatography (GC) but this is quite expensive

Introduction 2/2

- Soyeurt et al. (2006) have shown potential of FTIR for predicting fat composition, on a limited dataset (n=49)
- Already developed pred. eq. based on ~3600 obs
- The aim of this study:

Quantify the influence of season on prediction

Materials and methods 1/2

- Data: 1834 milk samples from ‘Winter’, 1826 milk samples from ‘Summer’, all from black HF cows
- GC analysis of milk fat → ~50 individual fatty acids
- FTIR analysis of milk → 1060 frequencies of IR
- Focus: Fatty acids (FA) expressed on fat basis (g/100g), alternatively on milk basis (g/dL)

Materials and methods 2/2

- Focus: C14:0, C16:0, C18:1*cis*9, C18:2*cis*9,*trans*11 (CLA) and the ratio of saturated to unsaturated fatty acids (ratioSFA:UFA)
- Partial Least Squares (PLS)
- Calibration on 50% data, validation on other 50%
- Calibration on winter and validation on summer and vice versa

Results 1/4 – trait differences

FA (g/100g)	winter mean	winter sd	summer mean	summer sd
C14:0	11.62	0.91	11.16	1.04
C16:0	32.61	2.83	29.19	3.50
C18:1 *cis*9	18.03	2.10	20.27	2.79
C18:2 *cis*9, *trans*11 (CLA)	0.39	0.11	0.56	0.27
ratioSFA:UFA	2.81	0.37	2.43	0.44

- Mean values were significantly different (P<0.001)

Results 2/4 – validation

FA (g/100g)	$r^2_{\text{win-win}}$
C14:0	0.50
C16:0	0.36
C18:1 *cis*9	0.66
C18:2 *cis*9, *trans*11 (CLA)	0.38
ratioSFA:UFA	0.72

Results 2/4 – validation

FA (g/100g)	r^2 win-win	r^2 win-sum
C14:0	0.50	0.44
C16:0	0.36	0.36
C18:1 *cis*9	0.66	0.66
C18:2 *cis*9, *trans*11 (CLA)	0.38	0.33
ratioSFA:UFA	0.72	0.68

Results 2/4 – validation

FA (g/100g)	r^2 win-win	r^2 win-sum	r^2 sum-sum
C14:0	0.50	0.44	0.60
C16:0	0.36	0.36	0.65
C18:1*cis*9	0.66	0.66	0.80
C18:2*cis*9,*trans*11 (CLA)	0.38	0.33	0.46
ratioSFA:UFA	0.72	0.68	0.85

Results 2/4 – validation

FA (g/100g)	r^2 win-win	r^2 win-sum	r^2 sum-sum	r^2 sum-win
C14:0	0.50	0.44	0.60	0.63
C16:0	0.36	0.36	0.65	0.53
C18:1 *cis*9	0.66	0.66	0.80	0.80
C18:2 *cis*9, *trans*11 (CLA)	0.38	0.33	0.46	0.36
ratioSFA:UFA	0.72	0.68	0.85	0.84

Results 3/4 – bias

FA (g/100g)	% win-win
C14:0	0.5
C16:0	0.4
C18:1 *cis*9	0.3
C18:2 *cis*9, *trans*11 (CLA)	2.1
ratioSFA:UFA	0.3

Results 3/4 – bias

FA (g/100g)	% win-win	% win-sum
C14:0	0.5	0.2
C16:0	0.4	3.3
C18:1 *cis*9	0.3	2.5
C18:2 *cis*9, *trans*11 (CLA)	2.1	7.0
ratioSFA:UFA	0.3	3.2

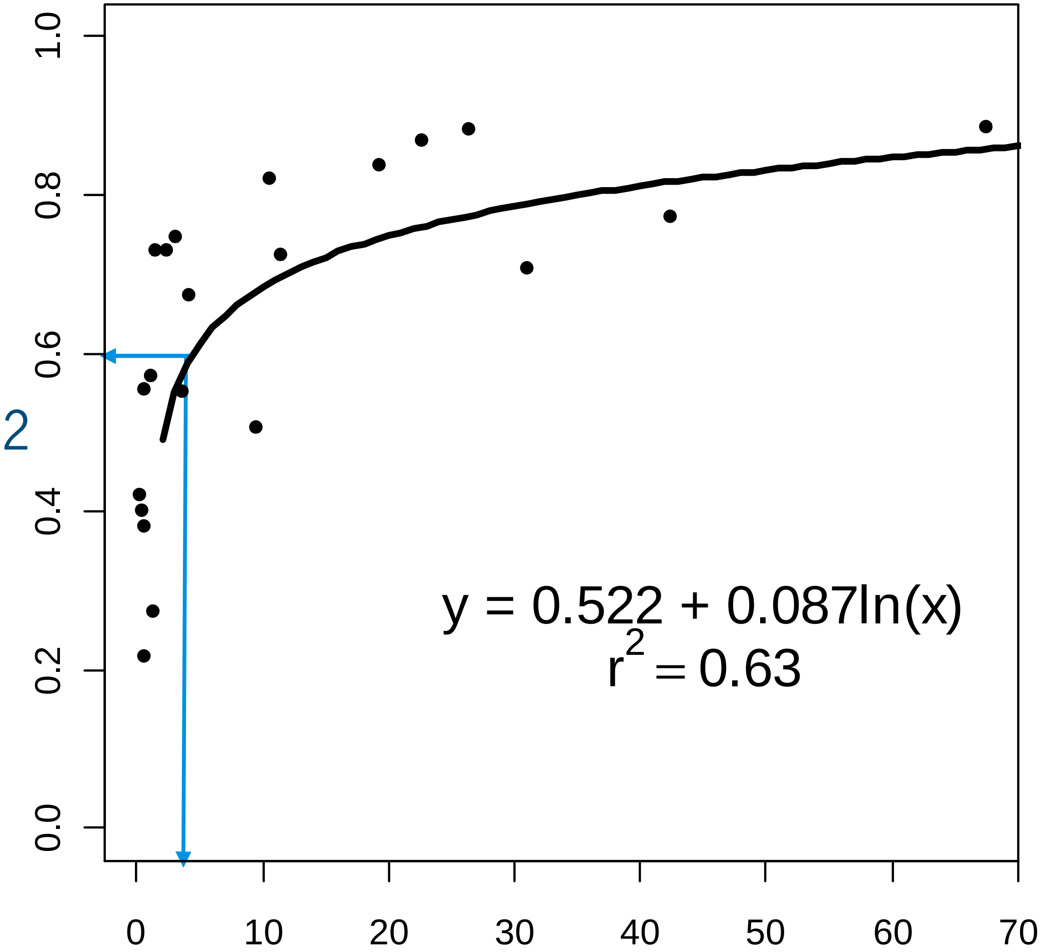
Results 3/4 – bias

FA (g/100g)	% win-win	% win-sum	% sum-sum
C14:0	0.5	0.2	0.9
C16:0	0.4	3.3	0.3
C18:1 *cis*9	0.3	2.5	0.3
C18:2 *cis*9, *trans*11 (CLA)	2.1	7.0	3.6
ratioSFA:UFA	0.3	3.2	1.2

Results 3/4 – bias

FA (g/100g)	% win-win	% win-sum	% sum-sum	% sum-win
C14:0	0.5	0.2	0.9	1.2
C16:0	0.4	3.3	0.3	7.4
C18:1 *cis*9	0.3	2.5	0.3	3.3
C18:2 *cis*9, *trans*11 (CLA)	2.1	7.0	3.6	17.9
ratioSFA:UFA	0.3	3.2	1.2	2.0

Results 4/4 – FA concentration vs. r^2



r^2

FA concentration (g/100g)

Conclusions 1/2

- Results of Soyeurt et al (2006) can be improved by using more data
- Effect of season on r^2 is small
- Effect of season on bias can be large for FA of low concentration
- Unbiased estimation of FA of low concentration requires data collected in several seasons

Conclusions 2/2

- Desired r^2 of ~0.6 requires FA with ~2.5 g/100g
- Desired r^2 of ~0.8 requires FA with ~0.2 g/dL
- There is scope on product differentiation or breeding value estimation for fat composition
- Helps the dairy industry to work towards human health supporting products

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- Thank you for your attention!
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FOSS

Qlip

The Dutch milk control station

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