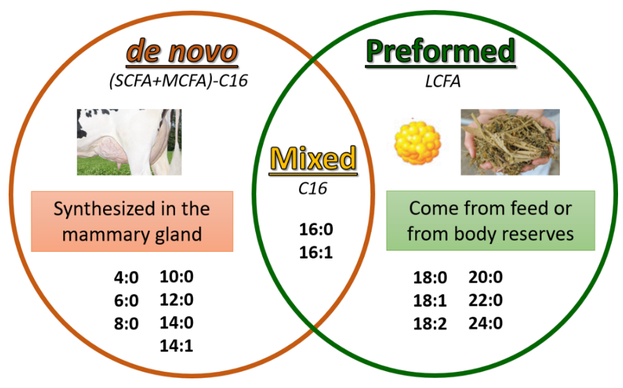
The use of fatty acid profiles from milk recording samples to predict body weight change of dairy cows in early lactation in commercial dairy farms

Dettmann F.[1,2], Warner D.[1], Buitenhuis A. J.[3], Kargo M.[3,4], Hostrup Kjeldsen A. M.[4], Nielsen N. H.[5], Lefebvre D. M.[1], Santschi D. E.[1]

[1]Lactanet, Sainte-Anne-de-Bellevue, QC, H9X3R4, Canada, [2]LKV Niedersachsen e.V., 26789 Leer, Germany, [3]Aarhus University, Center for Quantitative Genetics and Genomics, Department of Molecular Biology and Genetics, 8830 Tjele, Denmark, [4]SEGES, 8200 Aarhus N, Denmark, [5]RYK, 8200 Aarhus N, Denmark

| Background

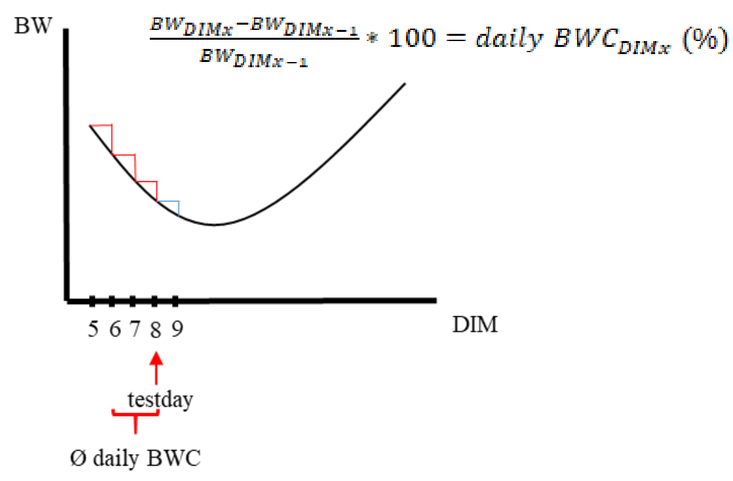
Most cows undergo a state of negative energy balance in early lactation. Body reserves then play a major role in milk fat production, while less fatty acids are newly synthesized in the mammary gland. This is reflected in the fatty acid composition of milk. The aim of this project was to validate if milk fatty acid profile can be used to predict body weight change in early lactating cows in commercial dairy farms.



Composition of FA groups in milk.

| Material and methods

- 17,067 Holstein cows at 7-35 days in milk across 166 herds (Lely AMS) in Denmark
- 19,371 test day records with a calculated body weight change (2015-2017)
- Milk fatty acids analyzed by FT-IR (MilkoScan, FOSS; Application Note 64)
- Based on a random forest model with ten-fold cross validation



Calculation of body weight change on test day.

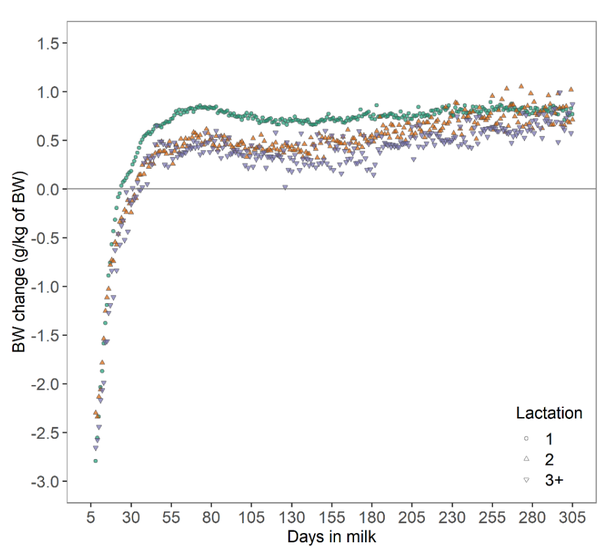
Characteristics of milk components and milk fatty acids (g/100g milk) in early lactation (DIM 7-35) Danish Holstein cows by parity.

	Parity 1 (n = 8,323 animals)					Parity 2 (n = 6,716 animals)					Parity 3 (n = 4,332 animals)				
Trait[1]	Mean	SD	p1	Median	p99	Mean	SD	p1	Median	p99	Mean	SD	p1	Median	p99
Fat (%)	4.50	0.97	2.56	4.38	7.44	4.25	0.91	2.43	4.16	6.86	4.33	0.98	2.41	4.25	7.25
Protein (%)	3.41	0.31	2.78	3.39	4.22	3.37	0.33	2.72	3.37	4.28	3.34	0.34	2.71	3.30	4.26
Fat:Protein	1.32	0.28	0.77	1.29	2.19	1.26	0.27	0.73	1.23	2.10	1.30	0.29	0.75	1.27	2.28
SFA	2.68	0.58	1.48	2.62	4.39	2.57	0.57	1.33	2.53	4.03	2.60	0.60	1.40	2.55	4.32
MUFA	1.33	0.41	0.66	1.27	2.67	1.23	0.37	0.62	1.17	2.42	1.28	0.42	0.62	1.21	2.65
PUFA	0.17	0.05	0.08	0.17	0.31	0.16	0.04	0.01	0.16	0.28	0.16	0.04	0.07	0.16	0.30
SCFA	0.43	0.11	0.23	0.43	0.74	0.43	0.10	0.22	0.43	0.69	0.44	0.10	0.23	0.43	0.72
MCFA	1.59	0.37	0.84	1.55	2.68	1.52	0.38	0.75	1.49	2.51	1.52	0.39	0.76	1.48	2.64
LCFA	1.90	0.59	0.85	1.81	3.74	1.76	0.54	0.78	1.69	3.42	1.83	0.60	0.79	1.75	3.77
MCFA	1.59	0.37	0.84	1.55	2.68	1.52	0.38	0.75	1.49	2.51	1.52	0.39	0.76	1.48	2.64
C 14:0	0.37	0.09	0.20	0.36	0.63	0.36	0.09	0.19	0.35	0.59	0.36	0.09	0.18	0.35	0.61
C 16:0	1.11	0.25	0.62	1.09	1.87	1.05	0.25	0.56	1.03	1.74	1.05	0.26	0.56	1.03	1.81
C 18:0	0.59	0.17	0.29	0.57	1.09	0.54	0.15	0.25	0.52	0.98	0.56	0.17	0.26	0.54	1.08
C 18:1	1.20	0.40	0.54	1.14	2.46	1.11	0.35	0.51	1.05	2.22	1.15	0.40	0.51	1.09	2.48

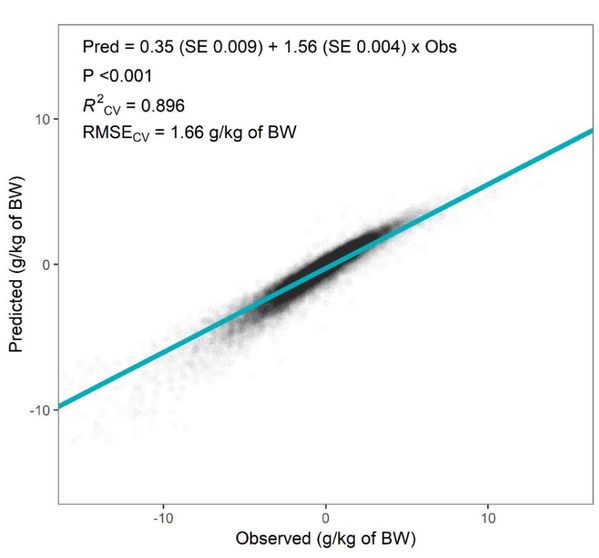
[1]Trait: SCFA = short-chain fatty acid; MCFA = medium-chain fatty acid; LCFA = long-chain fatty acid.

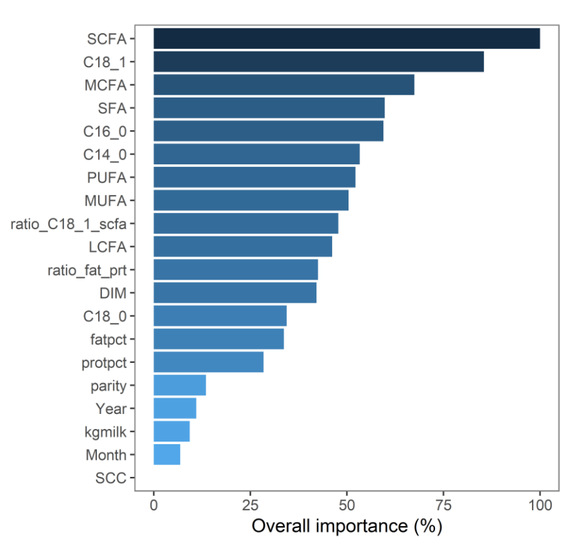
| Results and discussion

Relative body weight changes and body weight change curves



Prediction of body weight change based on milk fatty acid profile





- Daily BWC (median ± standard deviation): −0.32 ± 2.66 g/kg of BW (first parity), −0.46 ± 2.82 g/kg of BW (second parity) and −0.60 ± 5.53 g/kg of BW (third parity).
- Distribution of DIM from calving to nadir BW differed across parity: 26, 38, and 39 DIM for first, second, and third parity.
- SCFA and some MCFA are synthesized de novo in the mammary gland, oleic acid (C18:1) originates from body reserves (e.g., during energy deficits), and palmitic and palmitoleic acid (C16:0, C16:1) originate either from the de novo FA pool or from body reserves and from feed.

| Conclusion

The results suggest that the FT-IR milk FA profile may be used as an early indicator of BWC in early lactation cows. Nonetheless, before this model can be used in commercial farms, the model needs to be validated for different herd management and feeding strategies, breeds and country- or region-specific conditions. Further work is needed to assess the impact of the level of BWC on milk production, reproductive performance and health. Future models may gain from the inclusion of other milk components such as beta-hydroxybutyrate known to be linked to BW loss in early lactation. An early warning system may be implemented for cows with a large BW loss in early lactation based on the FT-IR milk FA profile.

| Acknowledgments

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