Keeping up with a healthy milk fatty acid profile require selection

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Alterations of FAs in raw milk

Butterfat in milk can be altered by…

- Feed
- **Genetics**
- Environment

FA profiles have multiple implications…

- Indicators for health traits
- Indicators for fertility
- Influence human health
  - Niche products
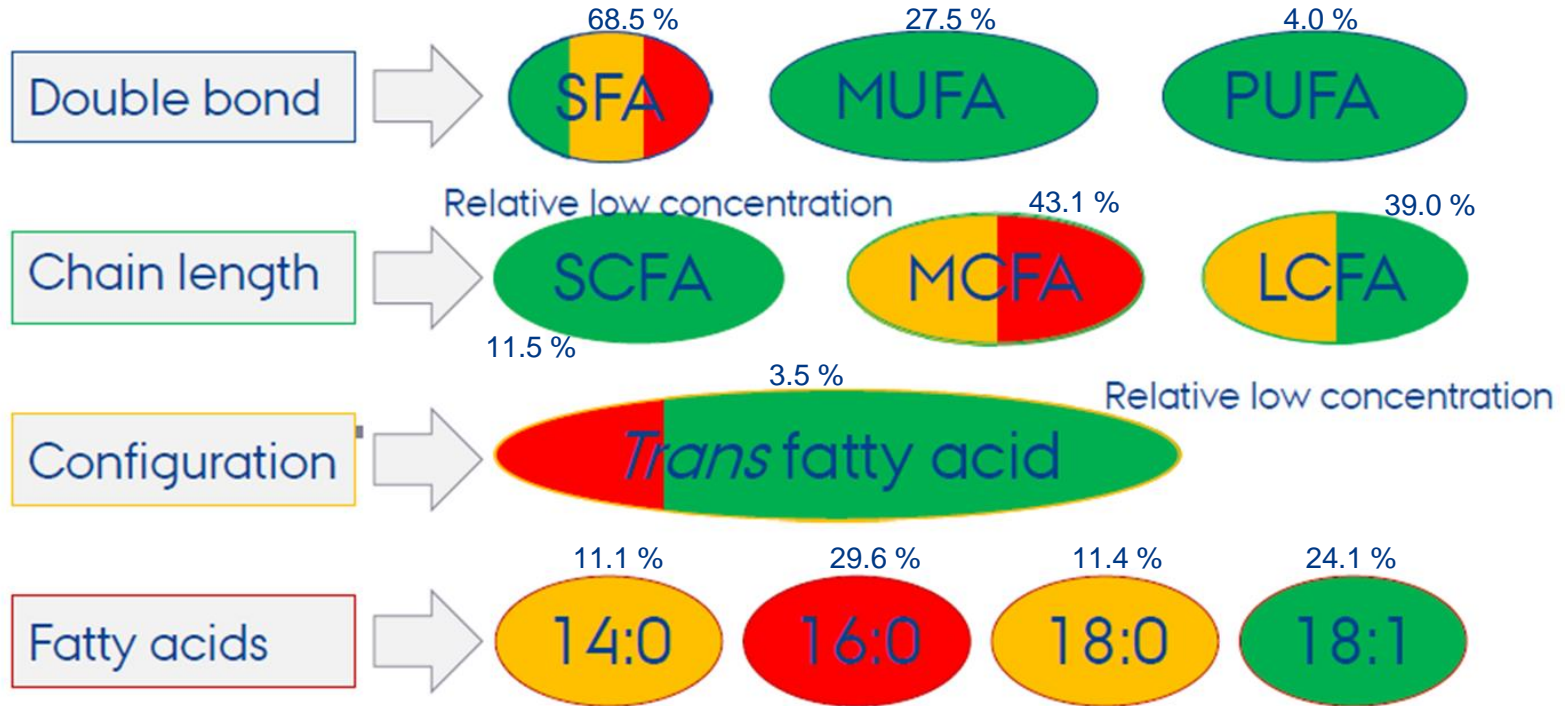 - Milk price

Danish fatty acid data

- 15+ million milk samples May 2015 – Dec. 2017
- Via the routine recording scheme
- Analyzed using MIR spectroscopy
- Fatty acid predicted using Foss Application Note 64
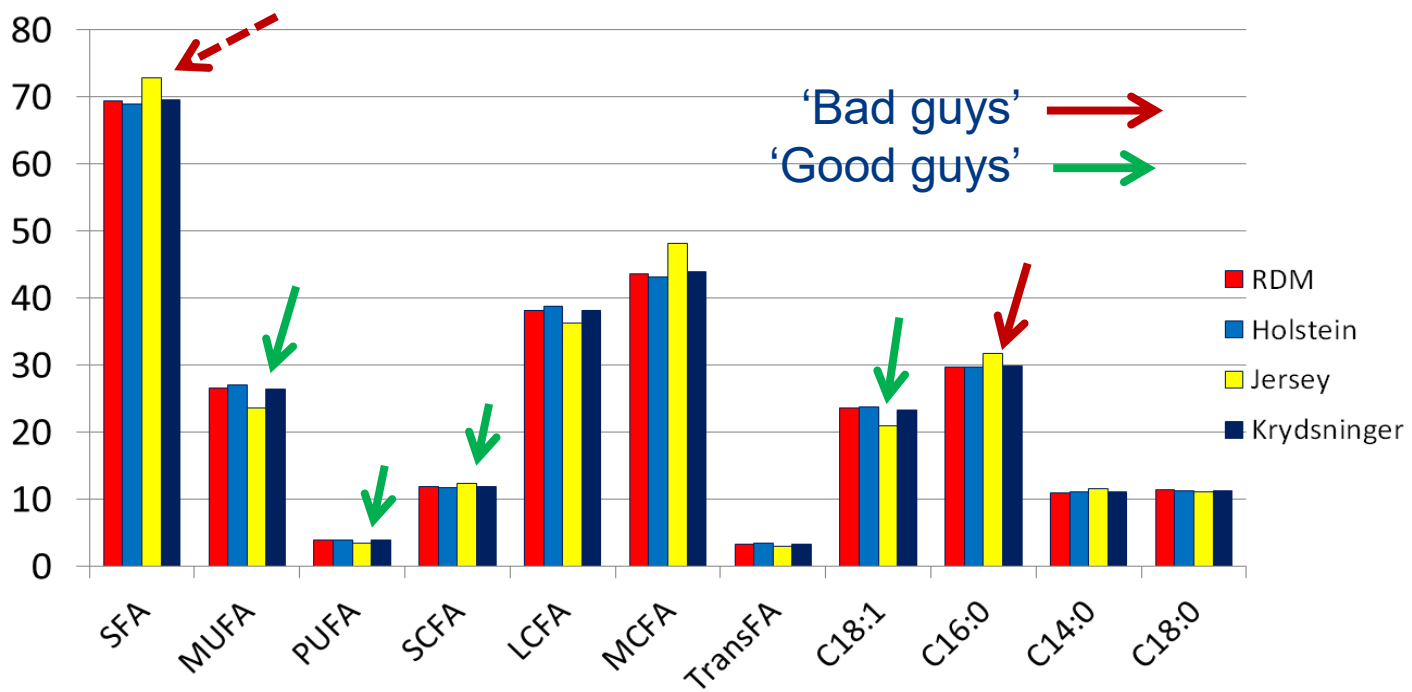- 11 categories (7 groups and 4 individual fatty acids)

FOSS Application 64

Fatty acid group	Name	
SFA	Saturated fatty acids	C4 – C20
MUFA	Monounsaturated fatty acids	C18:1 (C16:1, C14:1)
PUFA	Polyunsaturated fatty acids	LA. ALA, CLA
SCFA	Short-chain fatty acids	C4-C10
MCFA	Medium-chain fatty acids	C12-C16
LCFA	Long-chain fatty acids	C18 -
TransFA	Trans fatty acids	C18:1tr, CLA
C14:0	Myristic acid	
C16:0	Palmitic acid	
C18:0	Stearic acid	
C18:1	Oleic acid	

Fatty acids and human health

Differences between the different breeds in FA compositions

Heritabilities - Holstein

Fatty acid group	% of total fat	Amount, gram
SFA	0.15	0.19
MUFA	0.15	0.11
PUFA	0.08	0.09
SCFA	0.16	0.19
MCFA	0.12	0.20
LCFA	0.11	0.11
TransFA	0.07	0.06
C14:0	0.09	0.17
C16:0	0.14	0.20
C18:0	0.11	0.12
C18:1	0.13	0.11

Genetic correlations - Holstein

	% of total fat			
	MUFA	**PUFA**	**SCFA**	**C16:0**
MUFA	-			
PUFA	0.61	-		
SCFA	-0.69	-0.05	-	
C16:0	-0.64	-0.65	0.04	-
Total fat	-0.33	-0.26	0.33	0.17

Breeding values for FA's

Using the following univariate repeatability linear animal model:

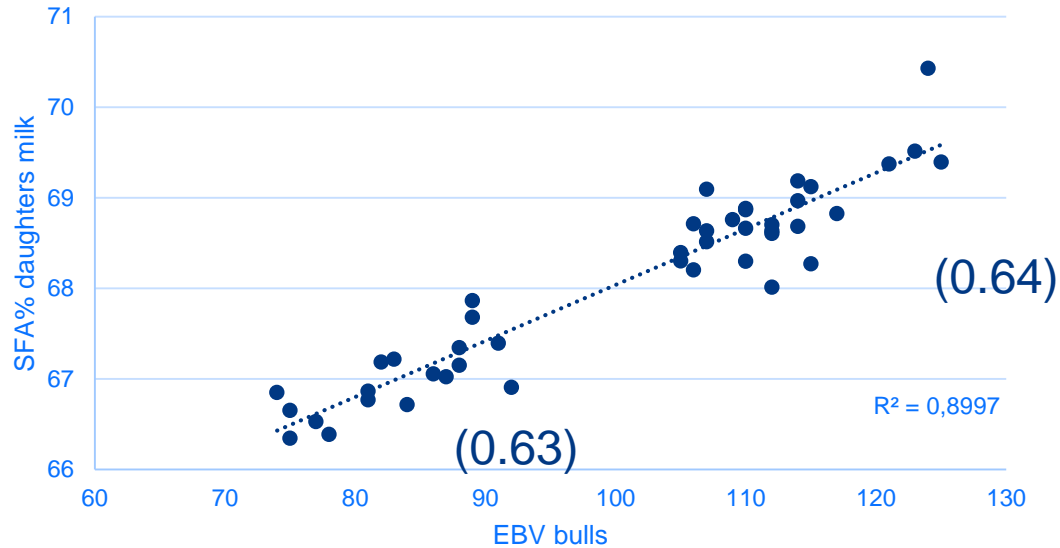$$y = \mathbf{X}b + \mathbf{Q}h + \mathbf{Z}a + \mathbf{W}pe + e$$

Fixed effects:

- month×year of recording

- DIM according to the Wilmink (1987)

Do these EBV's work?

- Bull with low and high EBV's for SFA% were selected
  - Low EBV(SFA% of total fat) : Average EBV: 81
  - High EBV(SFA% of total fat) : Average EBV: 114

Do these EBV's work?

Do these EBV's work?

- In seven Organic herds
    - 81 daughters of low EBV(SFA%) were selected
    - 113 daughters of high EBV(SFA%) were selected

- Milk from these were GC tested

- LS mean differences between these two groups:
    - GC SFA% of total fat: **1.98**

Low breeding value correlations
Holstein

NTM trait	MUFA,%	PUFA, %	SCFA, %	C16:0, %
Growth	-	0.10	0.09	-0.14
Fertility	-0.09	-	0.08	-
Mastitis	-0.12	-	0.12	-
Health	-0.11	0.05	0.13	-
Udder	-	-	-0.12	0.13

How to include FA's in the dairy BG ?

- Re-estimate ew. for all BG traits

- Keep overall ew. for yield and re-estimate ew. within the yield traits

- Keep the overall ew. for fat and:

$$\text{F-index} = v_1*MUFA + v_2* PUFA + v_3*SCFA + v_4*C16$$
Or
$$\text{F-index} = v_1*MUFA + v_2* PUFA + v_3*SCFA + v_4*C16 + v_5*Kg\ fat$$

Conclusion

- Data in place for routine EBV estimation in Denmark

- Data already used for management purposes

- We will be able to change FA content genetically

- Routine FA EBV's are however needed for doing selection

Thanks for listening, and thanks to all participants in this project…

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STØTTET AF
promilleafgiftsfonden
for landbrug

Undersøgelsen er en del af Organic RDD 2-projektet SOBcows

ICROFS Organic RDD | AARHUS UNIVERSITET | SEGES | det økologiske mejeri NATURMÆLK | VIKING | RYK | NordGen Nordic Genetic Resource Center | eurofins | Milk Testing