Breeding for improved milk quality:

Genetic parameters for milk fat composition

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Aims to identify possibilities to

breed

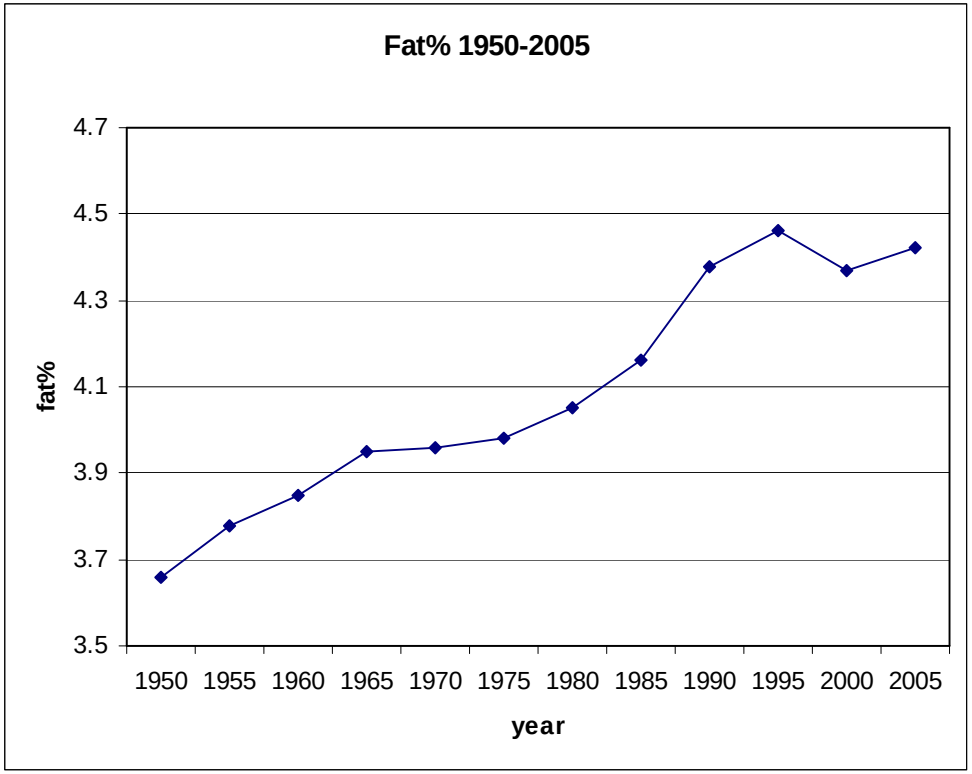
for improved

milk quality

Milk Fat

- Fat% routinely measured
- h^2 fat % = 0.50

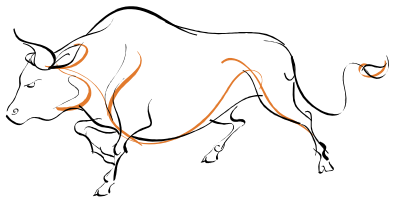
- Aims:
  - Average milk-fat composition?
  - h^2 fatty acids?
  - Increase in fat leads to …?



Source: NRS (2006)

Population

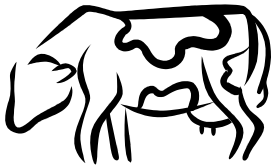
5 proven bulls



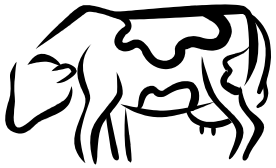
50 test bulls

46 proven bulls

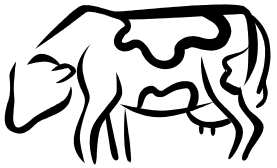
888 cows

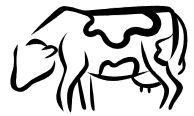
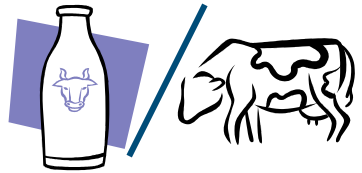


843 cows

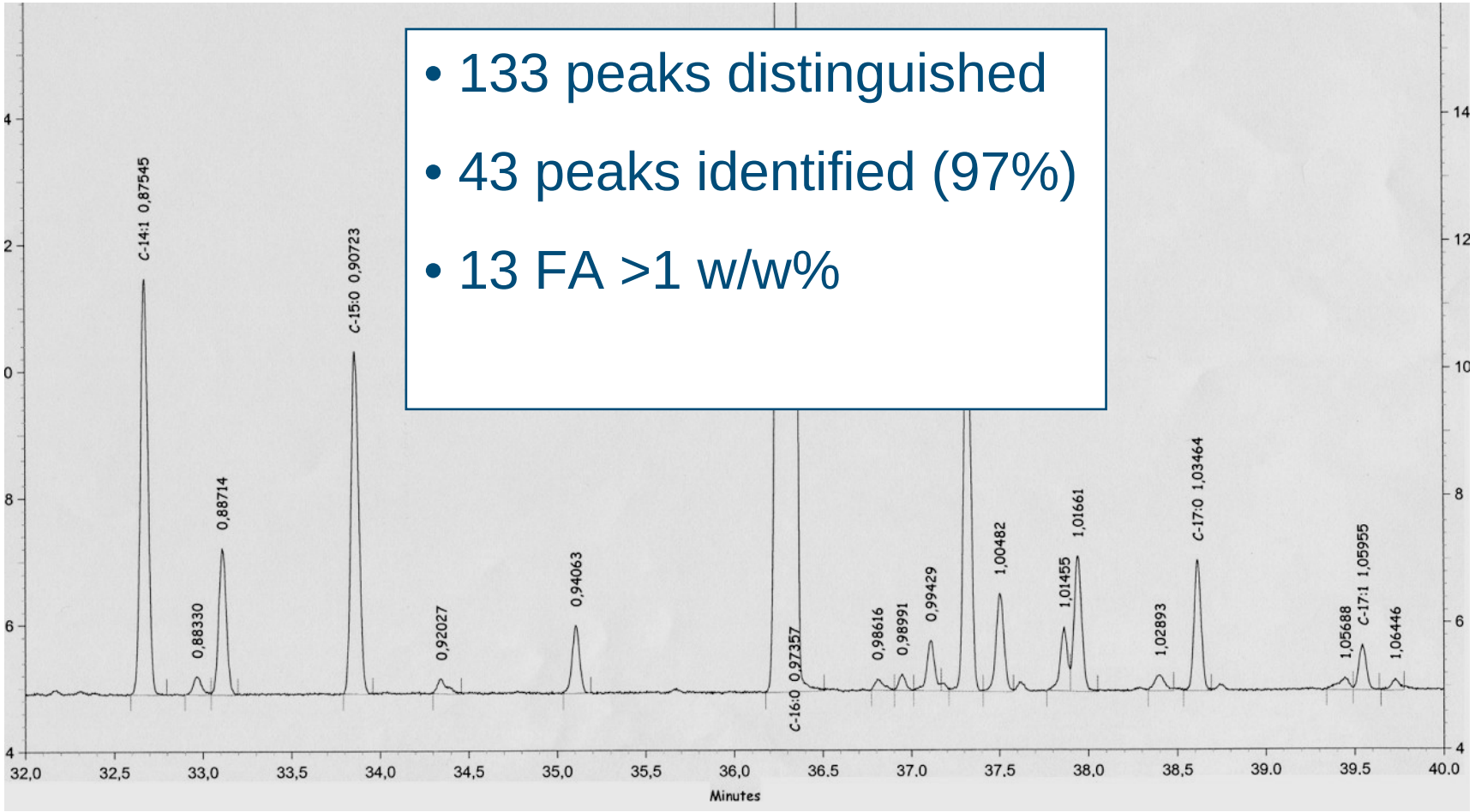


147 cows



- 1,918 
- 398 
- pedigree
- 1 
- winter 

Gas Chromatography



- 133 peaks distinguished
- 43 peaks identified (97%)
- 13 FA >1 w/w%

Average Composition

Fatty Acids	Mean (w/w%)	CV
C4:0	3.5	8
C6:0 - C12:0	10.7	11
C14:0	11.6	8
C16:0	32.6	9
C18:0	8.7	16
C18 unsaturated	21.6	11
Total identified	96.7	

Animal Model to estimate variances

$$y = mu + calving\_season + sire\_group +$$

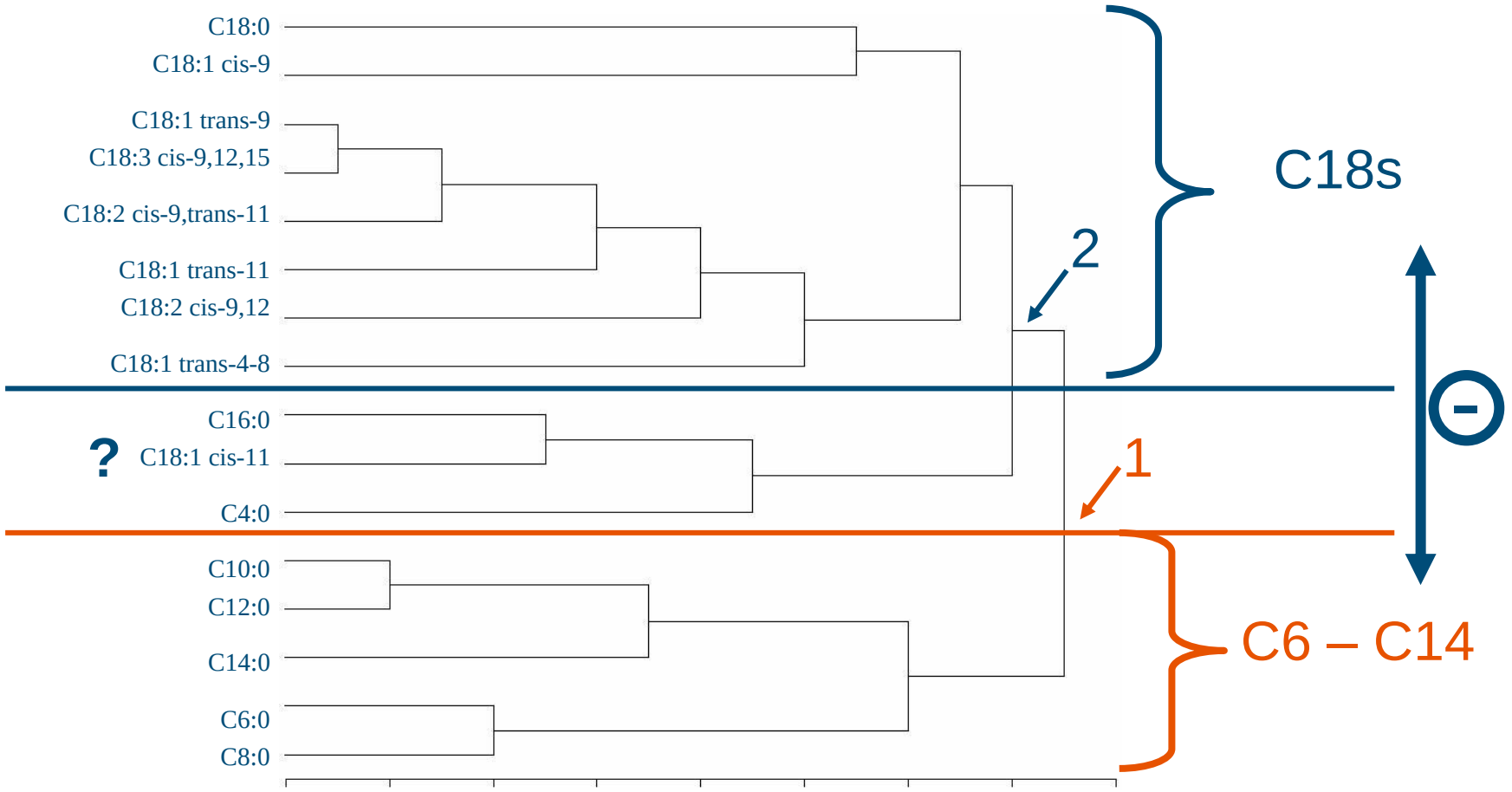
$$b_1*DIM + b_2*e^{-0.05*DIM} + b_3*afc + b_4*afc^2 +$$

$$herd + animal + e$$

Genetic Parameters: heritability

Fatty Acids	Heritability	Ratio Genetic/Herd
C4:0	0.42	2.09
C6:0 - C12:0	0.67	1.81
C14:0	0.59	2.75
C16:0	0.43	1.07
C18:0	0.23	0.98
C18 unsaturated	0.26	0.59
Fat%	0.51	6.25

Genetic Correlations



Number of Clusters

Genetic correlation with fat percentage

	Fat %	Protein yd
C4:0	0.16	0.04
C6:0 - C12:0	0.14	0.24
C14:0	-0.43	0.33
C16:0	0.65	-0.49
C18:0	0.01	-0.13
C18 unsaturated	-0.72	0.38

Conclusion

- Large genetic variation in milk-fat composition
- Short and medium chain fatty acids are under stronger genetic control than long chain fatty acids
- Genetic selection for fat results in relatively more C16:0 and less unsaturated fatty acids

Implication…

Milk fat composition can be changed by selective breeding. The genetic selection on fat tends to change milk fat composition in an unfavorable direction.

Stoop et al. 2008 J. Dairy Sci. 91:385-394