

Breeding for milk quality

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What is milk quality?

1. Milk should be produced by healthy cows → SCC < 500,000 cells/mL
2. General milk quality should be at a high level.....



What is the milk used for?

- a. Cheese production
- b. Yoghurt/milk
- c. Infant formula
- d. Whey products



Milk quality is related to:

1. Technological properties e.g. coagulation

2. Content of the milk

- a. Fatty acids
- b. Proteins
- c. Minerals
- d. Metabolites
- e. Vitamins
- f.



Breeding for milk quality

1. Variation (phenotypic, genetic)
2. Within breed variation
3. Between breed variation



DK-SE milk genomics project

- DK-SE milk genomics project focussed on 1,200 cows divided over 3 breeds (~400 cows/breed):



Danish Holstein

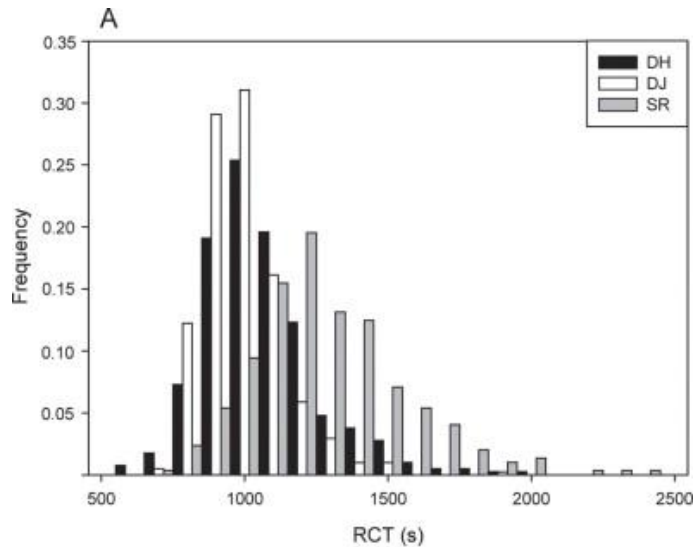
Swedish Red



Danish Jersey

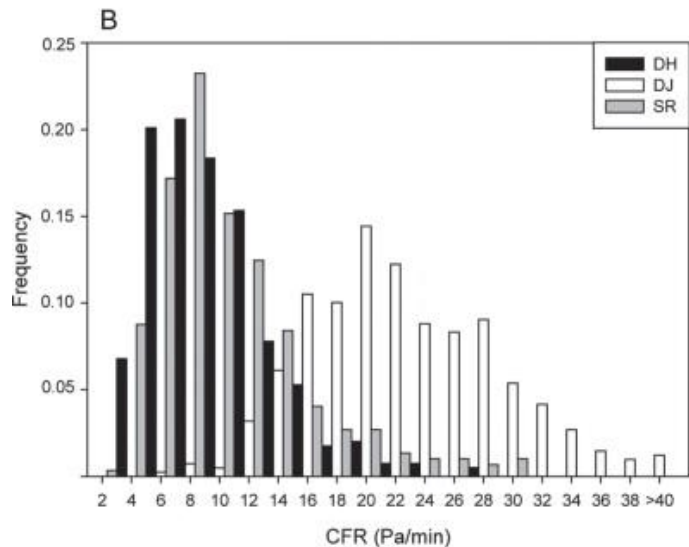
- Assess the phenotypic and genetic variation
- Detection of SNPs/Genes

Technological properties



Rennet coagulation time (cheese)

Variables	DH	DJ	SR	Influence of breed
RCT	1013 ^a	944 ^b	1233 ^c	***



Curd firming rate (yoghurt)

Variables	DH	DJ	SR	Influence of breed
CFR	8.97 ^a	21.63 ^b	9.49 ^a	***

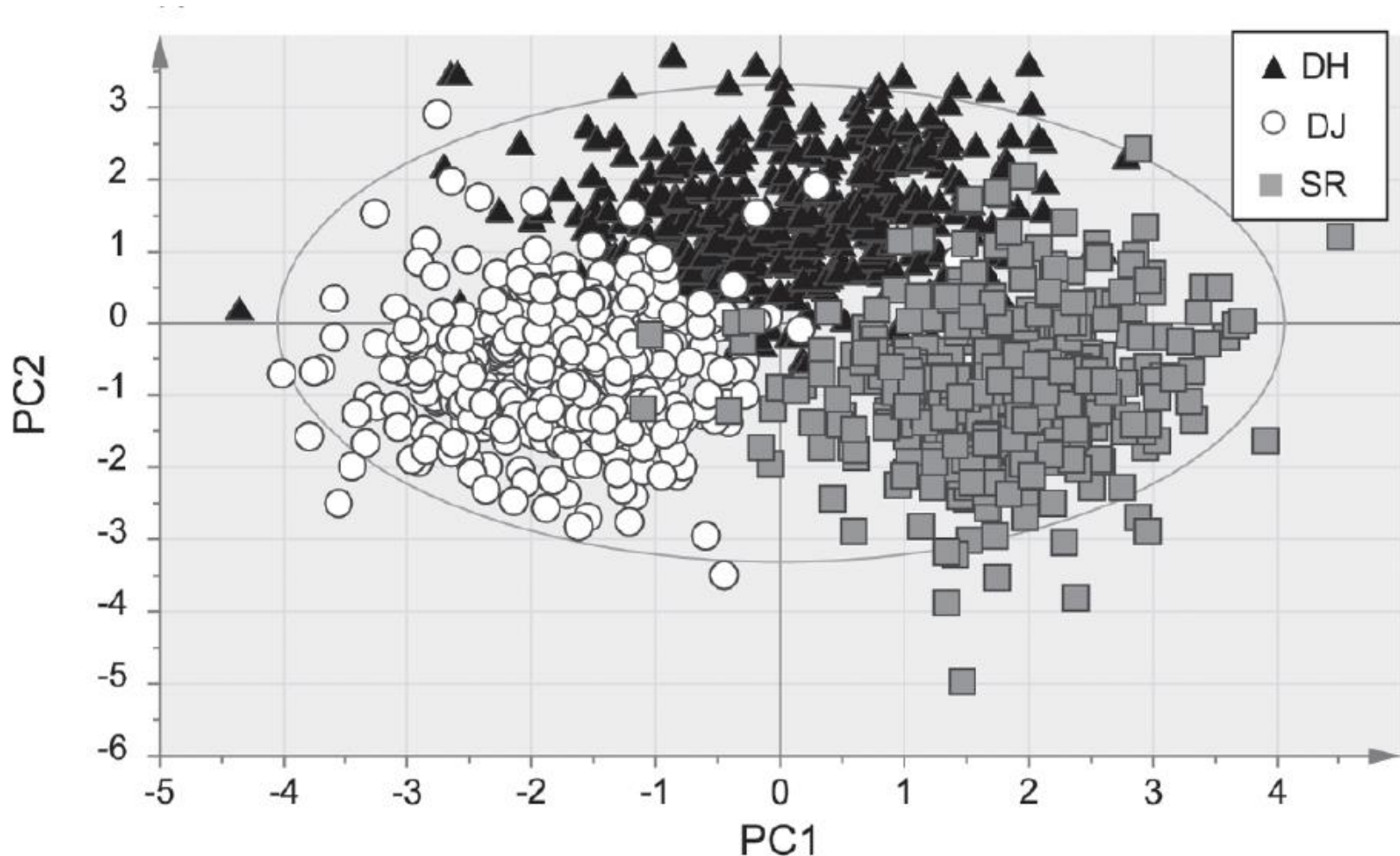
Technological properties

2% of the Danish Holstein cows and **16%** of the Swedish Red cows were unable to form a gel and categorized as non-coagulating

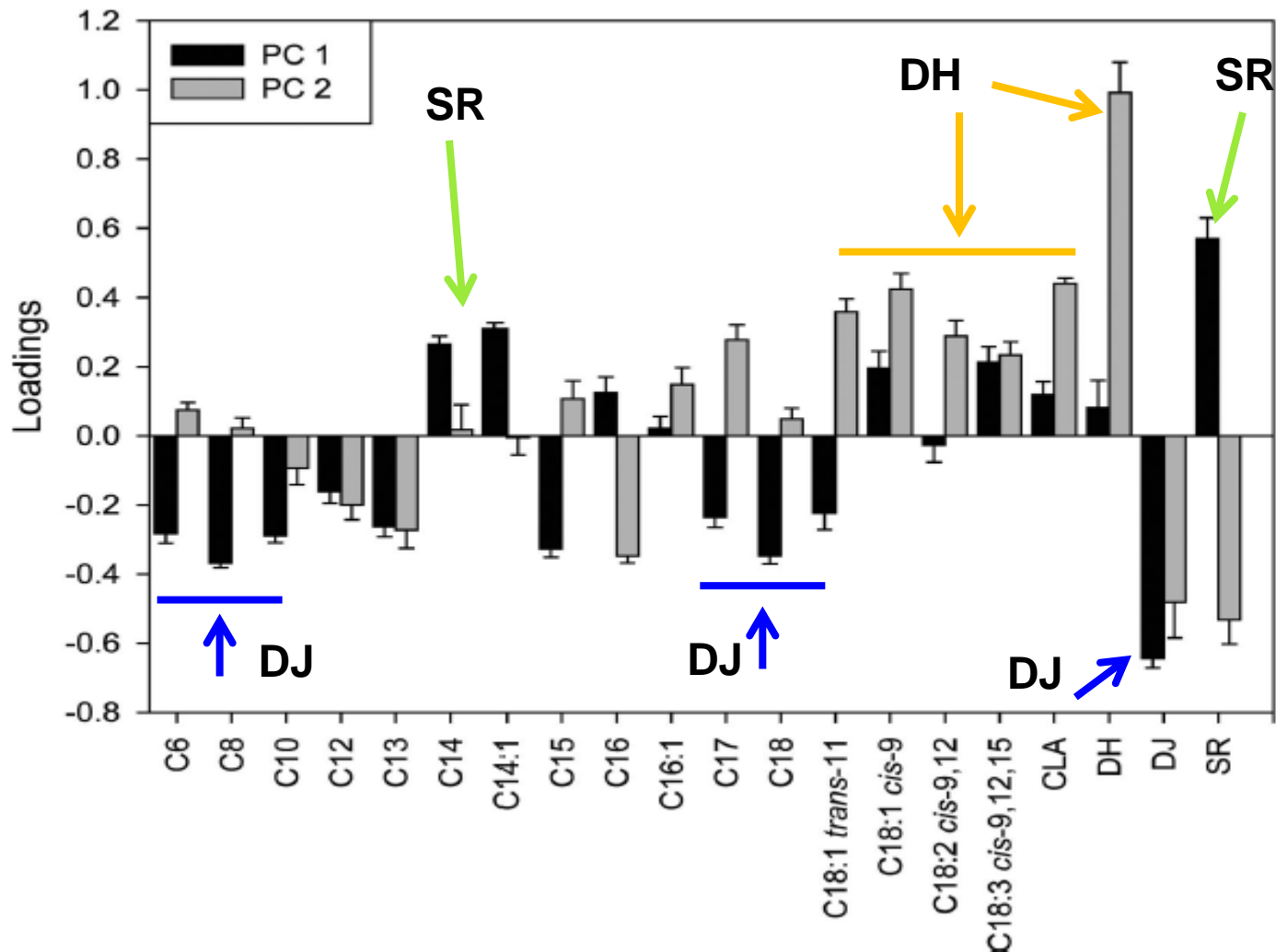
Heritability RCT: 0.28 (DH) ¹; 0.45 (DJ) ¹; 0.53 (SR)²

Heritability CFR: 0.15 (DH) ¹; 0.75 (DJ) ¹; 0.62 (SR)²

Fatty acid profile phenotypic variation



Fatty acid profile phenotypic variation



Fatty acid profile genetic variation

- There is genetic variation for the fatty acid profile in Danish Holstein¹ and Danish Jersey (unpublished)
- Performed a genome scan (bovine HD SNP array) for
 - Fat %
 - 16 individual FA
 - 4 FA index traits
 - 3 groups of FA

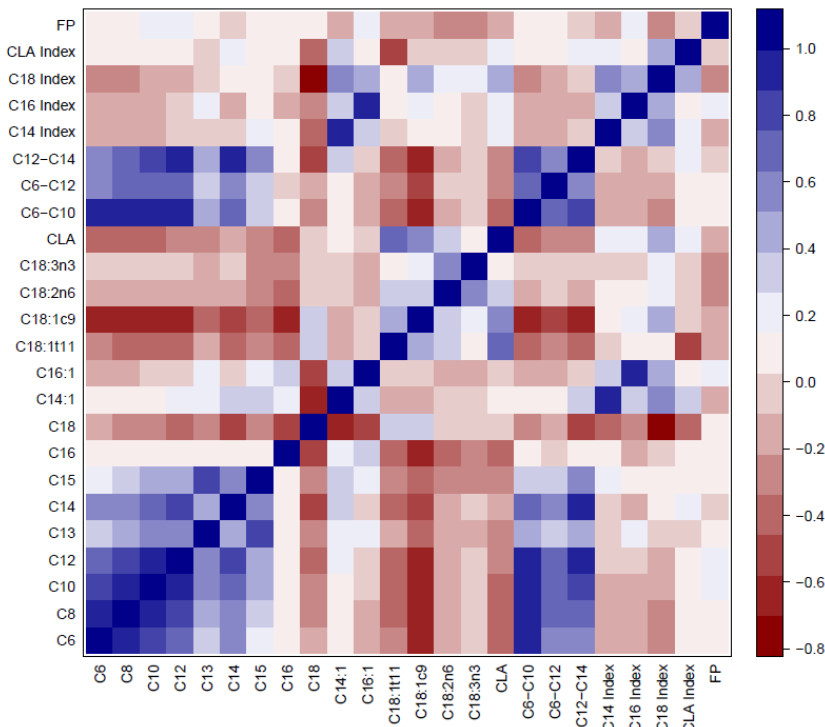


Pictures: Viking Genetics

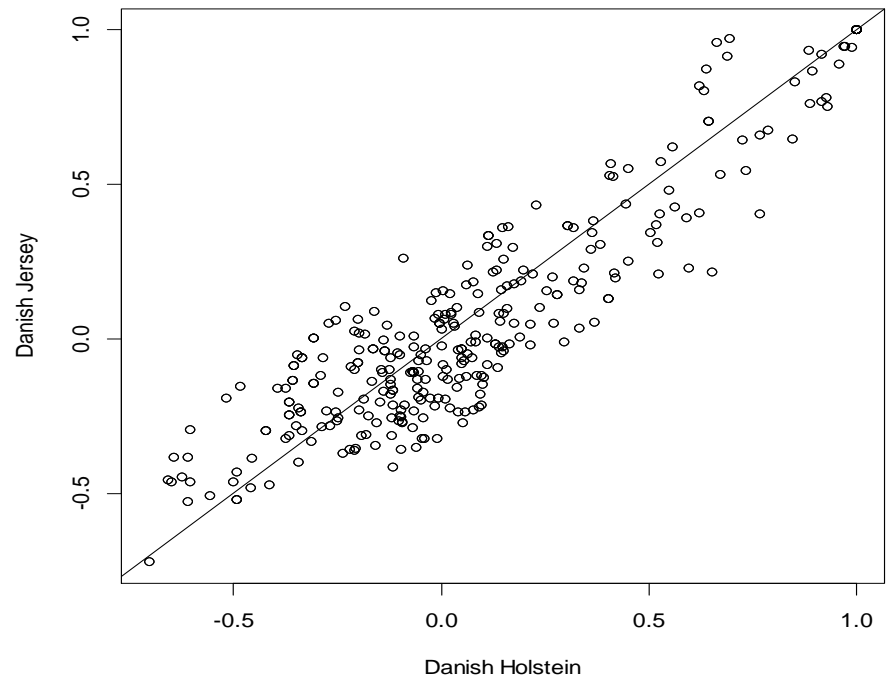
Fatty acid profile genetic variation¹

Within breed genomic correlation between FA is similar between Danish Holstein and Danish Jersey

Danish Holstein



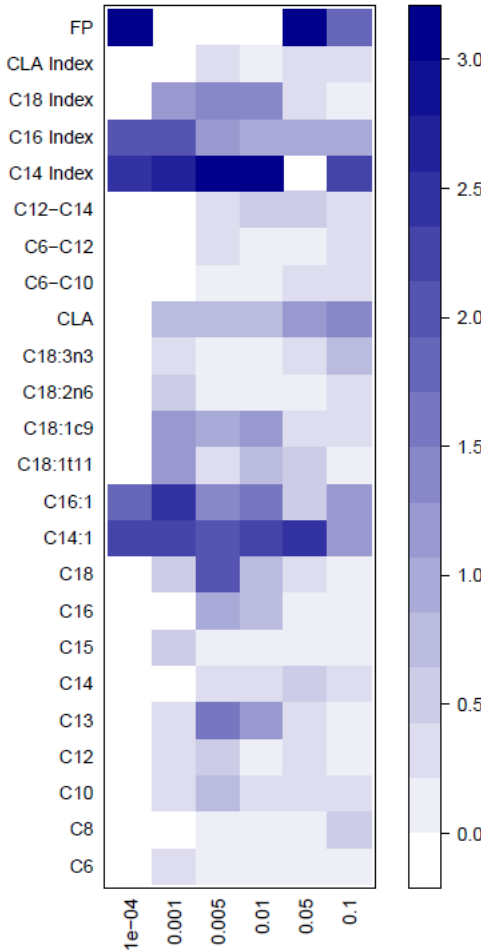
Trait Correlations



¹Buitenhuis et al. BMC Genomics (accepted)

Fatty acid profile genetic variation¹

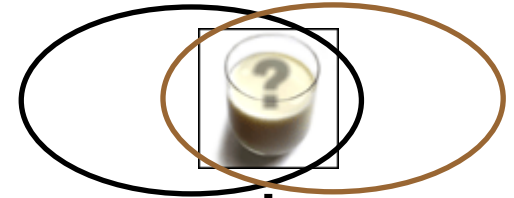
Overlap



→ DGAT area BTA14

→ SCD area BTA26

→ SCD area BTA26



Across breed prediction

¹Buitenhuis et al. BMC Genomics (accepted)

Conclusion

- Profound differences between and within breeds for technological properties and fatty acid profile of the milk
- Danish Holstein and Danish Jersey show the same genomic correlation structure for FA in the milk
 - DGAT and SCD were found significant in both breeds for fat% and C14:1, respectively
- Possible to select for specific milk properties, but is dependend on the economic value