Quality goat milk for cheese production

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Outline

- Challenges of the milk from Norwegian goats
- Experimental overview
- Results
- Discussion
- Future plans

Free range pasture, Lofoten

Foto: R. Inglingstad
Challenges of the milk from Norwegian goats

Changing consumer preferences are challenging milk quality

- Brown whey cheese (BWC)
  - High profiled nutrionists: “eating BWC is equivalent as eating milk chocolate on your bread”
- Rennet and acid coagulated cheeses

Production of rennet and acid coagulated cheeses requires milk of **high and stable** quality

- Coagulation properties
- Taste
Milk quality challenges

Extreme frequency (0,70) of a uniqueCSN1S1 “null” allele

- Synthesis of $\alpha_{s1}$-casein $\downarrow$
- Renneting properties $\downarrow$
- Lipolysis and FFA $\uparrow$

Seasonal variations in quality

- Quality (off-flavors and poor coagulation properties) most prominent during summer (mid lactation)

Production system

- Mountain pasture
- Feed quality and quantity
- Goats in negative energy balance $\rightarrow$ milk FFA $\uparrow$
Aims

To study

- the effects of **genetics** (CSN1S1 exon 12), **season** and **diet** on **milk composition and properties**
- compositional factors correlated with rennet coagulating properties

To find markers for good cheese milk
Experimental overview

80 goats randomly assigned in two groups S1 and S2

At ~130 DIM S1 and S2 goats were randomly assigned in 4 dietary groups:

- Forest pasture
- Cultivated pasture
- Early cut hay
- Late cut hay

Av. kidding dates
S1: 2\textsuperscript{nd} of February
S2: 1\textsuperscript{st} of April
Material and methods

Milk composition

- **Casein content** (pH 4.2) Kjeldahl analysis
- **Content of caseins** capillary electrophoresis.
- Mean **size of casein micelles** photon correlation spectroscopy
- **Lactose & somatic cell content (SCC)** FTIR analysis

Rennet coagulation properties  Formagraphe
Rennet clotting time (RCT), Gel firming rate (K20) Gel strength (A30)

Statistics – multivariate analysis

- Principle Componenet Analysis (PCA) and partial least square regression (PLS) (Unscrambler® V10.1)
Results: Content of caseins - effect of CSN1S1 genotype (exon 12)

Blue: no "null" allele (n=11)
Red: one "null" allele (n=30)
Green: two "null" alleles (n=36)
Results: PCA
milk composition and renneting properties
Results: Score plot

Effect of CSN1S1 genotype

Green: homozygous "null"
Red: heterozygous
Blue: homozygous "non null"
Results: Score plot

Effect of season

Blue = S1
Red = S2
PLS regression coefficients for A30.

Gray bars showing significant factors.
PLS regression coefficients for K20. Gray bars showing significant factors.
PLS regression coefficients for RCT

Gray bars showing significant factors
Results

- Shorter RCT and K20 and higher A30 was obtained in milk from goats in season 1 compared to season 2.

- It was not possible to detect major differences based on the four different diets.

- However, by comparing goats fed hay versus grass, we detected a distinct grouping with the more favorably properties in milk from goats grazing on pasture (cultivated and forest pasture).

- Goats homozygous for the deletion in exon 12 ("null" goats) displayed poor coagulation properties having the largest casein micelles and less content of total casein and αs1-casein. The effect of genotype was most apparent in season 2, where none of the "null" goats reached K20 (they may be more sensitive to reduced energy intake later in the grazing season?)
Results and discussion

- Content of αs2-casein is influencing positively on coagulation properties, and may compensate for the low content of αs1-casein in the “null” goats.

- Could lactose be used a rapid marker for coagulation properties?

- We were surprised to find levels of αs1-casein in the milk of the “null” goats. Will be confirmed later this autumn.
Future work

- Analysis of fatty acid profile (triglycerides and ffa)
- Ongoing project 2011: **Feeding different types of concentrates and effect on the milk quality**
  - Test period: from kidding to the 8th month of lactation
  - Three experimental groups of 10 goats:
    1) Control (carbohydrate-based)
    2) Saturated fat
    3) Unsaturated fat
  - Analysis of milk, blood and mammary tissue

- Analysis of the FTIR spectra (Milcoscan), correlation with traditional milk analysis
Thank you for your kind attention!

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