

# Non-coagulating milk from Swedish Red Dairy Cattle - Influence of milk composition, physical properties and genetic parameters

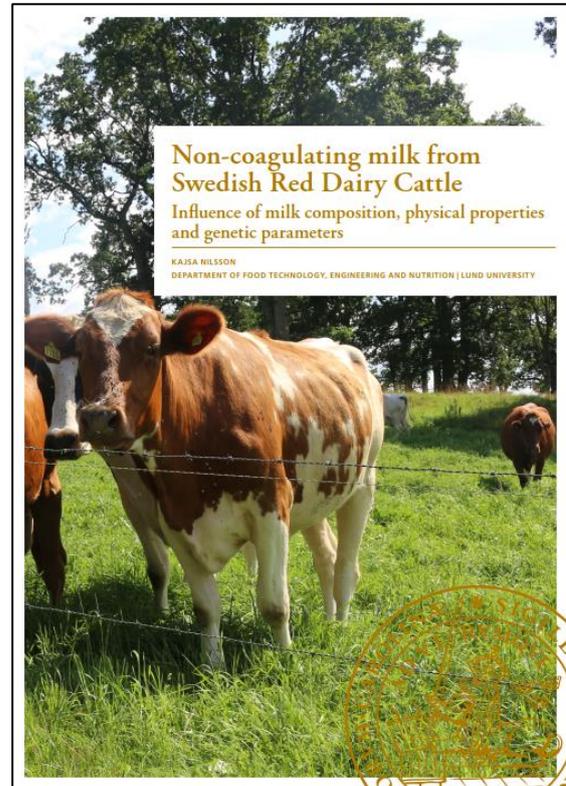
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## **Abstract**

Non-coagulating (NC) milk is unwanted in cheese production, as it lowers cheese yield and prolongs processing time. Less yield will lead to economic losses at the dairies. Even if NC milk has been found in several breeds, studies suggest that Swedish Red Dairy cattle (RDC) has a higher frequency of NC milk than most other breeds. In order to strengthen the competitiveness of Swedish RDC and ensure a versatile milk, it is therefore important to reduce the frequency of NC milk in this breed. The aim of this thesis has been to study NC milk from Swedish RDC from different perspectives and to determine the current frequency of NC milk within this breed. Further, by investigating the composition of NC milk samples as well as genetic parameters, the aim was to explore phenotypic markers that can be used in selective breeding to reduce the frequency of cows producing NC milk.

Milk samples from over 700 cows from Swedish RDC was collected and rheologically evaluated. The milk samples were also used to investigate milk composition, including a detailed protein profile with genetic variants, phosphorylations and glycosylations. Additionally, the enzymatic stage of the coagulation process was studied in both coagulating and NC milk samples, in order to determine if faults in the enzymatic or in the aggregation stage causes NC milk. Further, blood samples were collected, giving possibilities to combine knowledge about milk traits with genetic parameters.

The results showed that 18.1% of the cows produced milk that did not coagulate within 40 minutes after chymosin addition and was thereby defined as NC milk samples. Additionally, 18.9% of the cows produced milk that coagulated poorly, resulting in a total frequency of 37% of the cows that

produced milk which is not optimal for cheese production. NC milk was found to have a moderate estimated heritability of 0.28, suggesting possibilities for selective breeding of this trait. The study of the enzymatic stage showed cleavage of  $\kappa$ -casein in the NC milk samples, indicating that NC milk is caused by issues in the aggregation stage of the coagulation process, and not the enzymatic stage.

The combined information about milk traits and genetic parameters resulted in four suggested phenotypic markers. These can be used as indirect breeding parameters to reduce the frequency of NC milk in Swedish RDC. The four markers were:  $\kappa$ -casein,  $\alpha$ -lactalbumin, and calcium contents as well as genetic variants of  $\beta$ -casein. These showed different relations with NC milk, where NC milk contained lower  $\kappa$ -casein and calcium contents but higher  $\alpha$ -lactalbumin content compared to coagulating milk. The estimated heritability of these three parameters ranged from 0.12-0.77, showing different possibilities to use them within breeding. The genetic correlations for the three parameters with NC milk were all significant and moderate to high. Further, NC milk had a higher frequency of  $\beta$ -CN A2 and lower frequency of  $\beta$ -CN A1 compared to coagulating milk, which may also be used for breeding strategies.

This thesis has thereby pointed out phenotypic markers found in NC milk that have potential to be used in selective breeding in order to reduce the frequency of NC milk in Swedish RDC. A reduced NC frequency in Swedish RDC would strengthen the competitiveness of this breed by ensuring profitable and multifunctional milk, useful for several dairy products. This leads to an increased economic gain for stakeholders and a more sustainable dairy production.