Genetic parameters analysis of milk citrate for Holstein cows in early lactation

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Abstract: Delivering innovative and holistic monitoring and decision-making PLF tools relies on the availability of critical biomarkers. Negative energy balance is a difficult trait complex as there is a difference between perceived imbalance and physiological imbalance. Milk citrate is considered to be an early biomarker of negative energy balance for dairy cows in early lactation, but its genetic analysis is lacking. The objectives of this study were to (1) show the distribution of milk citrate content in early lactation; (2) analyze the genetic parameters of milk citrate. The coefficient of determination (R^2) and root mean square error (RMSE) of the predicted milk citrate model by milk mid-infrared (MIR) spectra in external validation were 0.86 and 0.76 mmol/L, and available from DIM 5 to 50 d. Records were divided into three traits according to the first (citrate1), second (citrate2), and from third to fifth party (citrate3+). After editing, the data included 134,517 records, from 52,198 cows, and 4,479 animals in the pedigree with 566,170 SNPs. A multiple-trait repeatability model was used in this study. The citrate is decreasing in early lactation, on average from 10.04 to 8.58 mmol/L from DIM 5 to 50 d. When cows start to be in energy balance (DIM $\approx$ 40 d), milk citrate was 8.82 mmol/l. The average of citrate1 was 8.93 mmol/l; citrate2 was 8.93 mmol/l; citrate3+ was 9.17 mmol/l. The heritability for citrate1 was 0.40; for citrate2, 0.37 and for citrate3+, 0.35. The ranges of genetic

correlations between the three traits were from 0.98 to 0.99, and of phenotypic correlations, from 0.41 to 0.42. This study shows that considering MIR-based milk citrate as an indicator to identify negative energy balance should be possible in early lactation and that this indicator could help select for animals less affected by negative energy balance.
Key words: milk citrate, negative energy balance, mid-infrared spectra