Summary

Recent research showed the usefulness of using estimated breeding values (EBV) for mid-infrared (MIR) based biomarkers in genetic improvement. A novel class of biomarkers was defined based on modelling responses of milk composition (e.g., mid-infrared (MIR) based) to stress expressed on continuous scales using reaction norm models. Heat stress is an important aspect of dairy production even in temperate climates as shown in recent studies. Implementation of genomic selection for tolerance to heat stress is therefore not only an issue for Australian dairy cattle, a country that introduced recently such an evaluation. The question remains open if using milk composition based heat stress resilience genomically enhanced EBV (GEBV) is not a viable option. Genetic parameters were estimated for production, udder health, and milk composition traits. Data included 202,733 test-day records for milk, fat, and protein yields, fat and protein percentages, somatic cell score (SCS), 10 individual milk fatty acids (FA) predicted by mid-infrared spectrometry, and 7 FA groups. Data were from 34,468 first-lactation Holstein cows in 862 herds in the Walloon region of Belgium and were collected between 2007 and 2010. Test-day records were merged with daily temperature-humidity index (THI) values based on meteorological records from public weather stations. The maximum distance between each farm and its corresponding weather station was 21 km. Linear reaction norm models were used to estimate the intercept and slope responses of 23 traits to increasing THI values. Most yield and FA traits had phenotypic and genetic declines as THI increased, whereas SCS, C18:0, C18:1 cis-9, and 4 FA groups (unsaturated FA, monounsaturated FA, polyunsaturated FA, and long-chain FA) increased with THI. Moreover, the latter traits had the largest slope-to-intercept genetic variance ratios, which indicate that they are more affected by heat stress at high THI levels and therefore good candidate traits. Among all traits, C18:1 cis-9 was the most sensitive to heat stress. As this trait is known to reflect body reserve mobilization, using its response to THI could be a very affordable milk biomarker of heat stress for dairy cattle expressing the equilibrium between intake and mobilization, and therefore adaptation, under warm conditions. Additional efforts are ongoing to define optimal and to validate the novel milk composition based heat stress resilience traits. First results from several studies seem to indicate that improved adaptation to heat stress is also beneficial to fertility and other functional traits. Finally we will put these novel milk composition based heat stress resilience traits in the context of genomic selection for more robust dairy cows in the Walloon Region of Belgium.

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Keywords: milk MIR spectra, blood biomarkers, genetic improvement, genomic selection