Genomic prediction of heat tolerance from rumen sensor data in Australian Holstein cows

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Heat stress negatively impacts livestock by reducing growth, milk production, and fertility performance. Genetic selection for heat tolerance in dairy cattle was first proposed using the rate of decline of milk production under heat stress as a phenotype. This method has been applied in several countries and was included in the national genetic evaluations in Australia. However, the uptake of this breeding value by farmers has been slow due to producer concerns that selecting for heat tolerance will reduce the performance of dairy cattle. Measuring other heat stress adaptations at scale has become possible with wearable sensors, like collars and rumen boluses, addition to farm management. The data being recorded and stored by these devices in turn provides the opportunity to access phenotypes that have been too labor intensive to measure. This study aims to investigate rumen temperature as a novel phenotype for genetic selection of heat tolerance in dairy cattle.

Weather data from the nearest weather station was retrieved from the Australian Bureau of Meteorology and used to calculate daily temperature-humidity index. Hourly rumen temperature data from 2019 to 2023 was retrieved for 920 Holstein cows across two farms in Victoria, Australia. Rumen temperature was corrected for water intake events and will be merged with production and performance data to investigate the relation between them. Cows (n=891) were genotyped for SNP positions on the Illumina BovineSNP50 panel using target capture sequencing. The genotypes were imputed to the custom XST74K SNP panel that is used for the standard genetic evaluations of Australian dairy cattle. Genetic parameters and variance components are being calculated using ASReml software.

The maximum difference within a cow for daily average rumen temperature was 3.6 °C. Across all cows, average daily temperatures ranged from 37.99 °C to 42.15 °C within the experimental period. This is a sizable difference given that even a 0.1 °C increase in body temperature can reduce fertility. The genetic estimates will be evaluated for their potential to predict heat tolerance in Australian Holsteins by comparing them to the current breeding values for heat tolerance included in the genetic evaluations. Exploring novel phenotypes, made accessible by wearable sensors, can help identify heat tolerant cows in ways that are less related to milk yield.