

Genetic associations between methane emission and other economically important traits

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Genetic selection for reduced methane (CH₄) emissions offers a promising strategy to improve the environmental sustainability of dairy production. However, before implementing a new trait in the breeding program, it is essential to understand its genetic relationship with other economically important traits. This study aimed to estimate genetic associations between daily CH₄ emission and traits currently included in the routine genetic evaluation of Norwegian Red dairy cows.

In Norway, large-scale phenotyping of methane emissions and feed intake of Norwegian Red cows is conducted across 14 commercial dairy herds. Methane measures are obtained using the GreenFeed system (www.c-lockinc.com). This study included a total of 548,116 daily CH₄ records from 2,387 cows collected from 2019 to 2025. Given the limited number of animals with CH₄ phenotypes, correlations between estimated breeding values (EBV) were used as an approximation for genetic correlations. Methane EBV for cows with CH₄ records were predicted with a linear animal repeatability model using the DMU software. The trait analysed was daily CH₄ emission (grams per day), calculated as the average of the cows' GreenFeed visits per day. Official GEBVs for all traits included in the current routine genetic evaluation were available from Geno. Methane EBVs were standardized to an index with a mean of 100 and a standard deviation of 10, and multiplied by -1 so that higher index values indicate lower CH₄ emissions, which are considered favorable. Correlations between EBVs for CH₄ and other traits range between -0.25 and 0.21. The strongest unfavorable correlations were to body conformation traits related to cow size (angularity, body depth, and stature) and to milk production traits (protein yield and fat yield). Favorable correlations were found with several fertility, health, and calving traits, most notably to the fertility trait "number of inseminations to conception" with a correlation of 0.20, but also to direct calf size, calving ease, and stillbirth. These results provide insight into the strength and direction of the underlying genetic correlations between traits. Understanding genetic relationships between key traits is essential when developing strategies aimed at breeding a feed-efficient, climate-friendly cow for the future.