20. Predicting nitrogen use efficiency of individual dairy cows by mid-infrared spectra

Rui Shi1,2,3*, Wenqi Lou1,2,3, Bart Ducro1, Aart van der Linden2, Yachun Wang3, Han A. Mulder1, Simon Oosting2

[1] Wageningen University & Research Animal Breeding and Genomics, The Netherlands
[2] Animal Production System Group, Wageningen University & Research, The Netherlands
[3] College of Animal Science and Technology, China Agricultural University, China
* Corresponding author. E-mail: rui.shi@wur.nl

Pollutants and waste of resources in dairy farms have negative impacts on the environment, such as ammonia, and nitrogen leakage to the soil. Meanwhile, the increasing demand for animal products will result in more pollution if N losses are not controlled. Therefore, a more efficient, and environmentally friendly production system is needed, in which nitrogen use efficiency (NUE) of dairy cows plays a key role. By selecting efficient cows, the adverse environmental impacts will be reduced. Generally, this kind of resource allocation trait is difficult to measure individually. For instance, it requires daily feed intake, which is costly to measure. To genetically improve NUE, extensively recorded and cost-effective proxies are essential. Previous studies obtained reasonable proxies for N related traits by including mid-infrared (MIR) spectra in their prediction models. A maximum R^2 of 0.82 was observed in their validations, which indicated the proxies are reasonable for further genetic analysis. The objectives of this study are (1) to develop an optimal prediction model of NUE, dry matter intake (DMI) and nitrogen loss (NL) for individual dairy cows in China, and (2) to investigate the contribution of input variables and their underlying relationship with N related traits. The data of this study were collected from a demo farm of Beijing, China. A total of 56 lactating Chinese Holstein cows, where days in milk ranged from 154 to 452, were offered the same diet during the experimental period in a free-stall design barn. After data editing, 600 records were retained for prediction and validation, and a total of 6 prediction models were developed for each trait. Results showed that R^2 of the optimal model reaches 0.69, 0.70 and 0.62 for NUE, DMI and NL, respectively. The infrared waves around 981.00 cm^{-1} and daily milk yield are the most important variables for prediction. This study developed powerful prediction models for N related traits of Chinese Holstein cows. These models will be applied to large-scale data to further investigate the genetic architecture of nitrogen efficiency. Milk yield is highly correlated with N output, and thus contributes significantly to the prediction. The most important wave range of MIR may comprise particular chemical compounds, which will be useful to unravel the biological mechanisms affecting NUE, DMI and NL in dairy cows.

Back to the overview