Validation of HappyMoo MIR energy balance models on external datasets with feeding restriction

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The Interreg HappyMoo project developed three sets of equations related to energy balance (EB). The first set concerns EB, dry matter intake (DMI) and feed efficiency. The second predicts fine milk components (oleic acid, beta-hydroxybutyrate, acetone, citrate), and the third concerns bodyweight and BCS. All models were developed based on European databases, including different countries, breeds and systems. An external validation was performed using feed restriction (FR) trials to ensure the ability of these models to detect energy deficit in case of FR. In the first external dataset, 30 Holstein dairy cows were studied at 21 days in milk and in mid-lactation, after which all cows were submitted to FR. The FR aimed to reduce the intake by 20% by adding straw to dilute energy and protein content in the ration. The second external dataset included 8 Holstein and 10 Montbéliarde mid-lactation cows that underwent 6 days FR with feed allowance reduced to meet 50% of individual energy requirements. The milk samples from these two datasets were analysed for fatty acids and selected metabolites and mid-infrared spectra were recorded and standardized before applying HappyMoo equations. The best performances were obtained for oleic acid (R^2=0.94 and 0.91 for the first and second dataset, respectively), then EB and DMI ($R^2 \geq 0.55$) but with a strong correlation with oleic acid. For BCS and bodyweight, the shape of the predicted curves coincided with observed values. For BHB, the lack of variability in the validation dataset did not allow to test the equations. In this study, oleic acid seems to be the best indicator to determine the nutritional status of the cow, presenting a good response to variations of nutrient allowance, even in mid-lactation.