Use of the milk MIR spectra with a lactation stage specific model to predict CH4 emitted by dairy cows

Amélie Vanlierde [1], Marie-Laure Vanrobays[2], Frédéric Dehareng [1], Eric Froidmont[1], Nicolas Gengler [2], Helene Soyeurt [2], Sinead Mcparland[3], Eva Lewis[3], Matthew H. Deighton[3], Pierre Dardenne[1]

[1] Département de Valorisation des Productions, Centre Wallon de Recherches Agronomiques (CRA-W) – Chaussée de Namur, 24, 5030 Gembloux, Belgique

[2] Université de Liège, Gembloux Agro-Bio Tech (ULg-GxABT) – Passage des Déportés 2 5030 Gembloux, Belgique

[3] Teagasc, Animal and Grassland Research & Innovation Centre, Moorepark, Cork, IRLAND

Methane (CH4) is naturally produced by cattle during ruminal fermentation. However CH4 is also the most important greenhouse gas produced by dairy cattle. In addition to environmental concerns, CH4 production implies losses of gross energy ingested. Consequently, the mitigation of those emissions is relevant in environmental and economic perspective. For this, the main levers of action are the diet composition, the genetic selection and the management of the herd. To investigate the link between those parameters and the CH4 emissions, an equation has been developed to predict easily individual CH4 emissions from milk mid-infrared (MIR) spectra [1]. Indeed, it has been established that CH4 emissions can be predicted from MIR equations. However milk FA composition is dependent on the stage of lactation as rates of body tissue mobilization differ [2]. This strongly influences the synthesis of the different milk FA and their relative proportion in milk and it should be considered to predict CH4 from MIR milk spectra. Therefore an innovative method was developed to reflect the expected changes in the relationship between CH4 and milk composition due to the metabolic status during lactation. For this, the MIR based prediction equation includes now the days in milk (DIM) information by the use of lactation stage specific prediction coefficients [3, 4]. A total of 446 CH4 reference data linked with the corresponding milk MIR spectra were obtained using the SF6 method on 146 Jersey, Holstein and Holstein-Jersey cows. Constant (P0), linear (P1) and quadratic (P2) modified Legendre polynomials were computed from DIM of cows the day of CH4 measurements and a first derivative was applied to the MIR spectra. The calibration model was developed using as variables first derivative x P0, first derivative x P1, first derivative x P2 and a modified PLS regression. The CH4 emission prediction (g CH4/day) showed a calibration coefficient of determination (R^2c) of 0.75, a cross-validation coefficient of determination (R^2cv) of 0.67 and the standard error of calibration (SEC) was 63 g/day. This equation has been applied on the milk MIR spectra database of the Walloon Region of Belgium (≈2,000,000 records) to check if the predictions match with the expected and biological meaningful behavior. The observed trend across lactation was similar to what was expected, i.e. an increase of averaged CH4 up to DIM 83 and a slight decrease after. This pattern shows that considering the DIM into the calibration bring relevant information when compared to predictions from previous equations.Taking the metabolism of the cows into account could be a good strategy to improve the equation.

Références

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