LIÈGE université
Gembloux
Agro-Bio Tech

Le Corps professoral de

Gembloux Agro-Bio Tech - Université de Liège vous prie

de lui faire l'honneur d'assister à la défense publique de la dissertation originale que

Monsieur KANDEL Purna Bhadra,

Titulaire d'un master degree in animal sciences, specialisation animal breeding and genetics,

présentera en vue de l'obtention du grade et du diplôme de

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 31 janvier 2018, à 14 heures précises (personne ne sera admis après cette heure),

en l'auditorium ZT1 (Zootechnie, bât. 1),

Passage des Déportés, 2, à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Genetic Relationships between Methane-related Traits and Milk Composition in Lactating Dairy Cows ».

Le jury est composé comme suit :

Président : Prof. L. WILLEMS, Vice-président du Département AGROBIOCHEM,
Membres : Prof. N. GENGLER (Promoteur), Prof. H. SOYEURT (Copromoteur), Prof. Y. BROSTAUX, Prof. Y. BECKERS, Dr E. FROIDMONT (CRAW), Dr Y. de HAAS (Université de Wageningen, Pays-Bas).

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Abstract

Methane (**CH_4**) emission is one of the most important environmental traits from dairy cows. Genetic selection programs aiming to mitigate CH_4 emissions require the estimation of genetic parameters, correlations with other economically important traits and predicted selection response of these traits. In first part of this thesis, CH_4 emissions (g/d; **PME**) were predicted from several milk fatty acid based prediction equations using mid-infrared (**MIR**) spectra of milk samples from Holstein cows. The heritability of PME was moderate and ranged from 0.21 to 0.40. The sires genetic variability were large enough to respond selection pressure. In second part and to minimize prediction errors, genetic parameters were estimated from direct prediction of CH_4 (i.e. based on SF_6 measurements) from milk MIR spectra. Predicted CH_4 intensity (**PMI**, g/kg of milk) was derived from the ratio of CH_4 (g/d) value divided by the total milk yield recorded for the considered test-day which is a trait that is comparable across different production systems. The relationship between PMI and milk yield (**MY**) was curvilinear and the distribution of PMI being non-normal, it was log-transformed (**LMI**) in further analyses. The genetic analyses were performed using two genetic models with or without random within-herd lactation curve effects along with random permanent and additive genetic effects. The results showed that the model with random within-herd lactation curve effects had a better fitting. The heritability of PME was 0.26 and PMI was 0.27. The contribution of random herd-specific lactation curve effects to the total variance also suggested an impact of herd specific management on the CH_4 emission traits. After confirming genetic component of CH_4 traits, genetic correlations of these traits with milk production traits were explored and expanded to second lactation. The phenotypic correlations between PME and MY, fat yield and protein yield were not different than zero but with LMI, the phenotypic correlations were highly negative. The genetic correlation was low negative between PME and milk production traits but high negative with LMI. The intra-lactation heritability and correlation were changing across lactation suggested there was dynamic relationship between CH_4 traits and milk production traits. After demonstrating correlation between milk production traits, the genetic correlation between CH_4 traits and functional traits [fertility, body condition score (**BCS**), longevity], health traits (udder health) and type traits were estimated. There were positive correlations between CH_4 emission traits and functional trait suggested there were tradeoffs between these traits in selection. The ingestion ability related type traits had positive genetic correlations with PME but negative genetic correlation with LMI. Finally, using the current Walloon selection index and by selecting PME and LMI, the emission traits responded by a reduction in CH_4 emission, without jeopardizing in milk production traits but having negative consequences in fertility, BCS and longevity. In conclusion, this study shows the feasibility to adapt the selection index to mitigate the CH_4 emitted by dairy cows.