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

Madame VANROBAYS Marie-Laure,

Titulaire d'un diplôme de master bioingénieur : sciences agronomiques,
à finalité spécialisée,

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

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 21 octobre 2019, à 13h00 précises (personne ne sera admis après cette heure),

en l'auditorium G (Bio-industries, Bât. 8),

Passage des Déportés, 2, à 5030 GEMBLOUX.

Cette dissertation originale a pour titre :

« Large-scale predictions of methane emission and body weight as tools contributing potentially to the genetic improvement of environmental sustainability of milk production ».

Le jury est composé comme suit :

Président : Prof. Y. BECKERS, Professeur ordinaire,
Membres : Prof. N. GENGLER (Promoteur), Prof. H. SOYEURT (Copromoteur), Prof. Y. BROSTAUX, Dr E. FROIDMONT (CRA-W), Dr F. DEHARENG (CRA-W), Dr S. MATTALIA (Institut de l'Elevage, Paris).

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Abstract

Maximizing profitability of dairy farms ensuring also mitigation of cattle environmental footprint is a major concern in milk production. Improvement of dairy cows' feed efficiency is of interest to achieve this goal as feed costs contribute largely to the variable costs in dairy sector and because feed efficiency is related to environmental concerns. As feed efficiency of dairy cows is influenced by several interconnected factors, many aspects of research could be addressed to improve it. For that, ample volume of reliable data from a lot of cows is required. Methane emission and body weight of lactating dairy cows have large influence on feed efficiency. However, these traits are difficult to measure at large scale in commercial farms. Therefore, the objective of this thesis was to improve predictions of daily methane emissions from milk mid-infrared spectra and body weights of lactating dairy cows in order to study the genetic variability of these traits and to investigate the opportunity of using them as tools to improve environmental sustainability of milk production. First, predictions of methane from milk mid-infrared spectra were improved by introducing the lactation stage information into the calibration process of the prediction equation in order to take into account the expected metabolic status of the cow. As milk mid-infrared spectra are collected routinely during milk recording, this equation allows to predict methane emissions of dairy cows at a large scale and at an individual level. High throughput screening of dairy cows for methane was conducted with mid-infrared methane predictions. Also, correlations between milk mid-infrared predicted methane and milk fatty acids were predicted throughout lactation. These correlations changed across lactation and these variations were related with the metabolic origins of milk fatty acids and then with the expected metabolic status of the cows over lactation allowing to confirm that integration of lactation stage in methane mid-infrared prediction equation was useful. Thereafter, a model was built to predict body weight of dairy cows throughout lactation from body weights estimated from linear conformation traits recorded at least once during the lactation. These predictions could be associated with milk production and composition as well as animal characteristics to estimate new traits related to feed efficiency like dry matter intake. Finally, this thesis demonstrated that methane emission and body weight of cows fulfill all criteria to be included in a breeding program in order to improve feed efficiency of dairy cows. To conclude, this thesis has shown that predictions of methane emission and body weight of dairy cows are traits of interest for widespread screening of herds in order to develop genetic selection tools to improve environmental sustainability of milk production.