Gembloux Agro-Bio Tech
Université de Liège

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 Virginie DECRUYENAERE

Ingénieur agronome,

Agrégé de l'enseignement secondaire supérieur,

Titulaire d'une Maîtrise spéciale en Génie sanitaire

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

DOCTEUR EN SCIENCES AGRONOMIQUES ET INGENIERIE BIOLOGIQUE,

le 17 décembre 2015, à 14 heures, en l'auditorium de Zootechnie 1 (ZT1),

Passage des Déportés,2 à 5030 **GEMBLOUX.**

Cette dissertation originale a pour titre :

"Estimation of diet digestibility and intake by grazing ruminants through near infrared reflectance spectroscopy analysis of faeces. Application in various contexts of livestock production"

Le jury est composé comme suit :

Président: Prof. M-L FAUCONNIER Vice-Présidente du Département AgroBioChem,
Membres: Y. BECKERS (Promoteur), P. DARDENNE (co-promoteur – CRAW), J. BINDELLE, G. LOGNAY, S. STILMANT (CRA-W), M. BORVAL (INRA)

UNIVERSITE DE LIEGE – GEMBLOUX AGRO-BIO TECH – SERVICE INSCRIPTIONS ET APPARITORAT
Passage des Déportés, 2 - 5030 Gembloux - Belgique
Téléphone +32(0)81 62 23 45 - Fax +32(0)81 62 21 68 - www.gembloux.ulg.ac.be

Virginie Decruyenaere (2015). Estimation of diet digestibility and intake of grazing ruminants through near infrared reflectance spectroscopy analysis of faeces. Application in various contexts of livestock production. (PhD Dissertation in English). Gembloux, Belgium, Gembloux Agro-Bio Tech, University of Liège, xxxp., 39 tabl., 12 fig.

Abstract

Grazing is the most economical feeding scheme for ruminants. Nevertheless, grazing management is often difficult for breeders. The lack of knowledge on grass availability and quality is pointed. Methods are available for estimating grass characteristics at quantitative and qualitative points of view but are difficult to apply for grazing ruminants. Near infrared reflectance spectroscopy (NIRS) is based on the absorption of infrared light by organic matters to provide NIRS spectra. NIRS spectra are correlated with chemical or biological composition to develop calibrations that are finally used as predictive models. The principal objective of this PhD thesis was to study the potential of near infrared reflectance spectroscopy applied to faeces (FNIRS) for predicting diet characteristics of grazing herbivore. More precisely, the studied parameters are *in vivo* organic matter digestibility, voluntary intake, and diet composition.

The main results underline the high potentiality of FNIRS to estimate *in vivo* digestibility and voluntary intake by grazing ruminants. Faeces appear as a good reflect of ingested diet. Our results, based on large or small and varied databases, suggest that FNIRS spectral libraries can be developed to characterise ruminants feed intake with success. The accuracy of the FNIRS models to estimate *in vivo* digestibility and voluntary intake is similar to or better than the accuracy of the others methods usually used for the estimation of these parameters. It appears also that FNIRS can be used predict animal diet composition, in term of plant species. Unfortunately, probably due to the lack of accurate procedures for determining diet selection individually, FNIRS predictions of botanical composition should be used only for ranking.

NIRS applied to faeces can be used to predict *in vivo* characteristics of forage with a sufficient accuracy. The prediction error of NIRS calibrations depends on the accuracy and precision of reference data. The prediction of *in vivo* digestibility and intake appears sufficiently repeatable in terms of performing the measure using the reference method. Intake is more difficult to predict with sufficient precision and appears to be more closely linked to the uncertainty of the FNIRS models.

The major difficulty of this method is to generate the diet-faecal pairs as reliable as possible. In regards to researches conducted with forage, the *in vivo* trials with animals confined in pens or digestibility crates appears to be the best reference methods to generate FNIRS calibrations. Future work will increase the use of FNIRS calibrations on independent data sets, under diverse grazing management schemes and its mobilisation to develop decision support system aiming to improve grazing management. The major concern will be to compare different feeding strategies rather than to estimate exactly feed intake values. As a low cost and rapid prediction technique, FNIRS contributes here to the development of methodology that could participate to the improvement of forage knowledge and or animal variability.