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 HERREMANS Sophie,

Titulaire d’un diplôme de master en 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 23 août 2019, à 9h 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 :

« Hydrolysable tannins: promising grass based silage additives for more environmentally friendly dairy systems? ». 

Le jury est composé comme suit :

Président : Prof. J. BINDELLE, Professeur ordinaire,
Membres : Prof. Y. BECKERS (Promoteur), Dr E. FROIDMONT (Copromoteur - CRA-W), Prof. N. GENGLER, Prof. B. BODSON, Dr G. CANTALAPIEDRA-HIJAR (INRA, France), Dr V. DECRUYENAERE (CRA-W).
Summary

Today, the livestock sector has to address multiple concerns. Being criticized for its environmental impact and competition for land use, a better efficiency at transforming vegetal proteins into animal proteins while limiting food-feed competition is now one of its main challenges. Several strategies have been identified to improve nitrogen use efficiency (NUE) and reduce environment damage of livestock production; the use of plant secondary compounds such as tannins is one of them. These natural molecules can bind with proteins and protect them against degradation by micro-organisms. Their action can thus help improve nitrogen efficiency and reduce nitrogen losses.

Our meta-analysis conducted on 58 experiments showed that tannins are generally ineffective at improving zootechnical performances but a shift in N excretion was observed, urinary N being reduced in favor of faecal N. However, hydrolysable tannins and the effect of tannins addition before ensiling have been little studied to date, unlike condensed tannins. This thesis thus aimed at testing the following hypotheses: i) hydrolysable tannin extracts can reduce proteolysis both in grass-based silage and rumen, ii) hydrolysable tannin extract added before ensiling can improve nitrogen use efficiency in lactating dairy cows.

The first experimental results showed that hydrolysable tannin extracts were effective at reducing ammonia-nitrogen content of silages suggesting a reduction of proteolysis. NH3-N proportion was reduced by 12 to 18% with oak tannin and up to 16% with chestnut tannin. Tannins also decreased ruminal nitrogen degradability of grass silage during enzymatic in vitro trial and in an artificial rumen. Proteolysis reduction thanks to oak tannin extract linearly increased with tannin dose in silage. The best dose range for oak and chestnut tannin extracts in silage seems to be around 30 g/kg of dry matter (DM) of forage. From 50g/kg DM, tannins showed a detrimental effect on in vitro organic matter digestibility.

The second part of the work revealed that oak tannins extract (added at 26g/kg DM in grass before ensiling) had no effect on nitrogen use efficiency of lactating dairy cows. However, a shift from urine to faecal nitrogen was observed in this trial in presence of oak tannins. This strategy can thus be adopted to decrease the environmental impact of ruminant protein feeding. This experiment also documented the use of the “nitrogen isotopic discrimination” proxy to compare nitrogen use efficiency of two contrasting diets. The results indicated that the proxy would specifically sign the N partitioning at the metabolic level rather than the overall NUE, the latter also being impacted by digestive processes.

The greatest interest of tannins would thus lie in their positive impact on environment preservation. The addition of tannin before ensiling seemed pointless in our conditions as compared to direct feeding given that the benefit from protecting proteins in silo did not persist in the rumen. The influence of pH on stability of hydrolysable tannin-protein complexes seems contradictory to literature data on condensed tannins. The specificity of tannin-protein complexes to both tannin and protein structures is a great challenge in the understanding of tannin impacts and the development of tannin applications in ruminant feeding.