Short Term Scientific Mission (STSM) Report

COST action: FA 1302 – METHAGENE
COST STSM Reference Number: COST-STSM-FA1302-37134
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STSM Topic: Rumination time and methane emissions relationships in a multibreed dataset

Purpose of the visit

The overall goal of this STSM was to investigate the possible correlations between methane emission and rumination time in Holstein and Jersey cows.

Overview of the visit

For the first three days, literature research and data editing were performed. It is a well-known fact that high fiber diets contribute to higher CH_4 production, by increasing the rumen pH and decreasing the rate of passage of digesta. Rumination time is also known to increase when cows are put on a higher fibers diet: it increases saliva production, which prevents low rumen pH, favoring acetogenic fermentation, contributing to higher CH_4 production; also, mastication during rumination reduces particle size, contributing to rapid fermentation by ruminal microbes. Therefore, rumination seems to have direct effects on digesta turnover, consequently affecting dry matter intake and CH_4 production.

Initially, our dataset was composed of 355 Danish Holstein and 153 Jersey cows, in a total of 508 animals, with 2,431,008 observations for rumination. The data was recorded by a sensor-based system that records rumination activity sounds produced by jaw or ear movements, and it was collected at the Danish Cattle Research Center, in Foulum, Denmark.

Methane data was recorded by a sniffer approach, which measures CH_4 and CO_2 concentrations in the breath of cows. This is non-invasive method, which seems to be viable for commercial herds. In our study, CH_4 was recorded by the Guardian NG/Gascard (Guardian Plus; Edinburgh Instruments Ltd., Livingston, UK). The gases are measured during individual milkings, through a ceramic filter installed in the concentrate bins of automated milking systems (AMS).

From those animals, all 355 Danish Holstein cows also had repeated CH_4 records; however, only 85 of the Jerseys had CH_4 information. Therefore, at this step of the data editing, we've decided to remove the Jerseys, since it would be very difficult to obtain genetic estimates for such a small number of animals. A bigger Jersey dataset could help to our work, but unfortunately, so far, we don't have access to more records.

However, for the Holsteins, we carried on with the data editing. We've decided to keep only first parity. We've struggled a bit in the beginning with the pedigree, which seemed incomplete, and, as it turns out, we had Jerseys information mixed in it, so this was keeping our analyses to converge. After a close and careful screening and editing of the pedigree, we were able to run our models, and to get some results. Table 1 shows the results of single trait models, for both CH_4 and rumination time.

Table 1. Heritabilities (h^2), additive genetic variance (V_a), phenotypic variance (V_p), repeatability and standard errors (SE) of estimates for CH_4 and rumination time

	h^2	SE	V_a	V_p	Rep	SE
CH_4	0.23	0.20	1,478	6,985	0.47	0.20
Rum	0.26	0.09	8.90	91.80	0.52	0.09

In Table 2, estimates of correlations between the traits studied can be seen. A bivariate model was used to get the estimates.

Table 2. Genetic (r_g), permanent environment (r_i) and residual (r_e) correlations and standard errors (SE) estimates between CH_4 and rumination time					
r_g	SE	r_i	SE	r_e	SE
-0.52	0.47	-0.07	0.20	-0.05	0.02

As it can be seen from our results, SE are high, therefore the results are not significant. This is due to the small number of cows we have available for rumination and CH_4. It would be ideal to have more accessible data, but unfortunately recording millions of records for CH_4 is still a challenge to be overcome. International collaboration among countries where CH_4 data is being gathered would be a simple way of overcoming this challenge.

Regarding our findings, a different approach will be tested, in order to try to obtain more reliable estimates. We plan to keep the collaboration between Aarhus University and Wageningen University, by perhaps keeping both institutions working on the current project, and hopefully, a publication will come out of this STSM.