Report of the Short Term Scientific Mission of Dr. Diana Sorg

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COST Action FA1302

Host institution:	Poznan University of Life Sciences
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1. Purpose of the STSM

Methane emissions from dairy cows are measured with different techniques by many researchers. If these data are to be compared or even to be combined for genetic evaluation, it must be known how the techniques agree with each other. During this STSM, methane profiles of dairy cows were taken with a mobile Laser Methane Detector (LMD) and with a Fourier Transform Infrared Detector (FTIR) installed in an automatic milking system (AMS) to analyse the agreement of the two methods.

2. Work carried out

FTIR measurements were carried out during milking in the AMS. Air exhaled by the cow while she was eating the concentrate dispensed in the feed bin was sampled (figure 1). The analyser unit located on top of the milking shed (figure 1) was continuously recording the methane profiles of the exhaled air during the entire milking procedure and stored them in the database as the average concentration from 5 seconds periods.

Fig. 1: FTIR methane measurement in the automatic milking system (AMS) (left and centre), pen to hold a cow during the LMD measurement after leaving the AMS (right)

A gate and a bar was installed behind the exit of the AMS, such that a small pen was constructed. Cows leaving the AMS were restrained there for the LMD measurement (figure 1). With this setup, the LMD profiles could be taken immediately after the FTIR measurement. The LMD measurements were taken at 1 m distance from the cow's mouth, so that the values recorded in ppm-m by the LMD could be transformed to ppm by dividing by 1 m (figure 2). The LMD (figure 3) is a portable, hand-held device which specifically measures the column density of methane in air without contact to the source by infrared spectroscopy. The wavelength of the laser is specifically set to the absorption of methane. The data are sent via Bluetooth connection to a smartphone running the GasViewer app. The app stores the data in a .csv file on the phone from where they can be transferred to a computer.

Fig. 2: Measurement of a cow with the Laser Methane Detector after leaving the automatic milking system

Fig. 3: Laser Methane Detector with GasViewer App on a smartphone (Crowcon Detection Instruments Ltd., Abingdon, UK)

3. First results

Cow profiles

During 4 consecutive days, a total number of 102 profiles from 40 cows was recorded with the LMD. The number of profiles recorded is shown in table 1. Each of the LMD profiles has a corresponding FTIR profile which was recorded immediately before.

Table 1: Profiles recorded with the LMD during the STSM

Day	1	2	3	4	Total
LMD profiles	10	32	30	30	102
Number of animals	10	28	28	29	40[1]

[1]Animals have repeated measurements over the 4 days

An example of a cow profile taken with the LMD is given in figure 4. The eructation events with high methane values are clearly visible as a series of high peaks, repeating regularly.

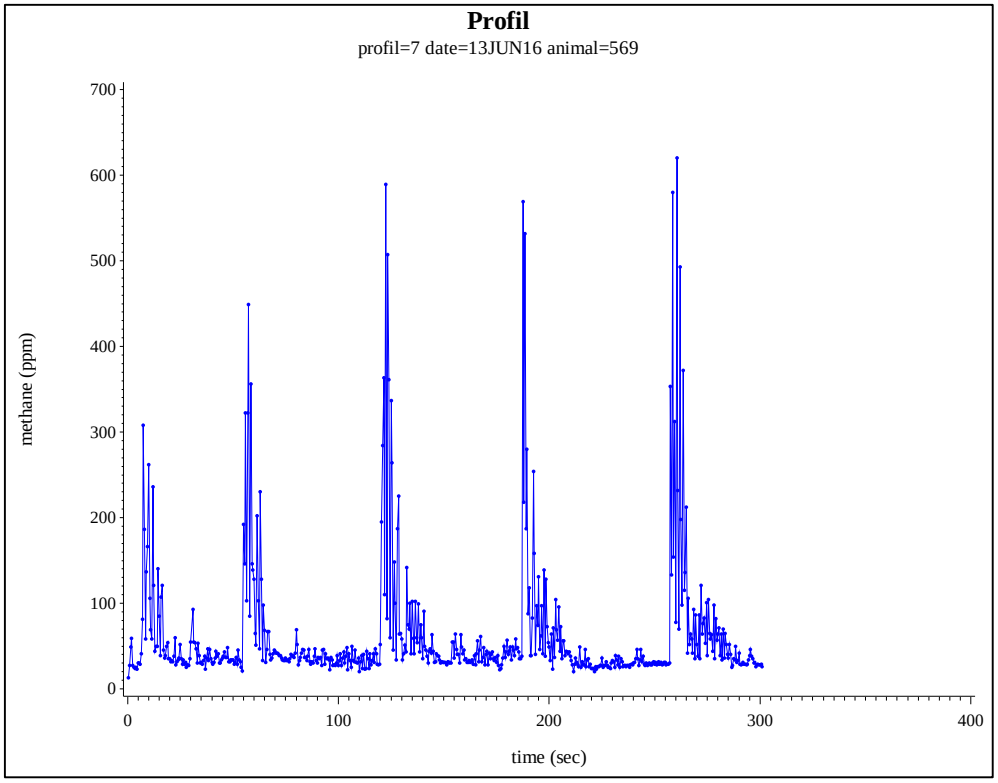

Fig. 4: Profile taken with the Laser Methane Detector

Descriptive statistics

Table 2 shows the descriptive statistics of the LMD and FTIR data.

Table 1: Descriptive statistics of the methane phenotypes

variable	N	mean	median	SD	CV	min	max
		(ppm)	(ppm)	(ppm)	(%)	(ppm)	(ppm)
LMD - profile mean	102	48	42	18	38	20	104
FTIR – profile mean	102	552	551	161	29	133	937

Agreement of the techniques

First analyses of the raw data collected during the experiment showed that a Pearson correlation of mean LMD and FTIR methane was not significant (p=0.12). The LMD values were lower than the FTIR values, but both had a similar coefficient of variation between profiles. Further, more elaborate analyses will be performed to investigate this missing significance of the correlation.

4. Planned analyses

- condense LMD and FTIR profiles to other point measurements to test different methane phenotypes in parallel
- further comparison of the techniques via correlation and regression analysis for other phenotypes
- modelling of influential effects
- repeatability of the measurement over days

5. Conclusion

The STSM was very successful in terms of that a valuable data set has been collected with the LMD and FTIR technique, which has - to our knowledge - not been done before. A working protocol has been established which allows to record LMD profiles of cows immediately after they have been measured with the FTIR technique in the AMS.
Our data show that we need to make a more thorough comparison in order to better characterize the relationship between the techniques. More phenotypes derived from the data should be investigated which might have the potential to have a higher correlation, regarding the different measuring conditions (partially enclosed feed bin in the AMS, open space with the LMD). These are only preliminary analyses on raw data which have not been further processed. A final conclusion cannot be drawn before more elaborate analyses will have been made. Afterwards, other researchers in METHAGENE and elsewhere could use our findings to compare their data taken with these two techniques.

6. Future collaboration with the host institution

Further analysis of the data obtained during the STSM will be carried out together. A continued comparison of the two measuring techniques is possible. This work could also be the foundation for shared research projects on methane emissions from dairy cows or other topics in genetic selection.

7. Foreseen publications

The data from this comparison are to be combined with data from other experiments, which will then be published in a peer-reviewed journal.

8. Confirmation of the host institution of the successful execution of the STSM

See the attached letter from the host institution.