Towards a robust protocol for enteric methane measurements using a hand held Laser Methane Detector in Ruminants

ThiphaineBruder[1], Benoit Rouille[1], Tianhai Yan[2] & ***Mizeck G.G. Chagunda[3]***

[1]Service Productions Laitières, Monvoisin – BP 85225 – 35652, LE RHEU Cedex, France
[2]The Agri-Food & Biosciences Institute, Hillsborough, Northern Ireland, UK
[3]Future Farming Systems Group, Scotland's Rural College (SRUC), Edinburgh, EH9 3JG, Scotland, UK,

Abstract

Direct measuring of enteric methane in breath of ruminants is becoming popular. Since the first peer-reviewed publication (Chagunda et al., 2009) showed the potential application of the proprietary Laser Methane Detector® (LMD) in ruminants, it has been shown to have strong relationship with traditional techniques such as respiration calorimetric chambers. For example, Chagunda et al, (2013) reported sensitivity and specificity for cows of 95.4% and 96.5%, and for sheep, sensitivity was 93.8% and specificity was 78.7%. However, there is no joined-up protocol covering all aspects, including, data collection, data extraction, data handling, and estimating methane volume from the measured concentration.
Using data from two studies this paper presents results from tests and analysis to develop a method for data extraction, determine optimal recording duration, differentiating breath from eructation; and conversion of methane concentration to volume. The first study used a group of 71 dairy cows with repeated measurements over a 5 week period. Methane was measured by pointing the LMD at the nostril of the cow from a distance estimated to be 1m in the feed-face after midday milking. Measurements lasted 4 to 5 minutes. For each individual time-series measurement, time of recording and cow's tag number were recorded. In the second study measurements were taken from 18 Holstein Friesian heifers simultaneously by the LMD and the metabolic chamber.
In differentiating eructation from breath, one standard deviation for the individual measurement-window, was used as a threshold. This proved to be a biologically meaningful and statistically effective way of distinguishing methane coming from the rumen through eructation and that from the normal breath. An example is the mean of 395.8 (with a standard deviation of 182.7) ppm. To determine the optimum recording duration, five levels of 60s, 120s, 180s, 240s and 300s were created. Gross average of methane emissions was calculated for each recording window. Significant difference was tested using analysis of variance (ANOVA). In this test the only group that resulted in significantly low measurements ($p<0.001$) was the 60s. Given that eructation episodes in cow breath cycles are estimated to be one to three per minute, measurement windows of less than 3 minutes would risk missing out on some eructation episodes. When methane was measured when animals were standing the relationship between LMD methane and Chamber methane was highest ($r = 0.65$) while daily averages had the weakest relationship ($r = 0.48$). This strong and positive

correlation allowed us to build regression equations for estimating methane volume (g/day) from methane concentration (ppm) measured by the LMD.

Key words: Enteric methane; measuring protocol, breath cycles