Paper ID: 1092
Theme 5. Environmental issues related to grassland
Sub-theme 5.1. Climate change and grassland management

# Methane emission estimated from different cattle intake data in heifers grazing a tropical pasture

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**Keywords:** Data, Methane intake, Pasture

## Introduction

The quantification of methane ($CH_4$) from enteric fermentation related to cattle diet is a useful tool to identify strategies to mitigate greenhouse gas emissions. This is even important in tropical and subtropical regions due to the lack of $CH_4$ estimations in beef cattle, particularly from *Bos Indicus* breeds grazing tropical grasses (Kurihara *et al*., 1999). Several modelling approaches have been developed in order to predict $CH_4$ emission. However, the use of these models has limitations associated with uncertainty information required such as feed intake (FI), composition of the selected diet and animal responses (Gonzalez *et al*., 2014). FI is the main factor influencing $CH_4$ emission. Individual FI measurements are not easy to achieve accurately in grazing animals rather than those located in pens, particularly under deferred tropical pastures at the end of the dry season, due to the large proportion of death forage. In this case, cattle supplementation with energetic and proteins concentrates, is a viable practice in order to improve animal FI and reduce $CH_4$ emissions. The main objectives of this study was estimate and compare $CH_4$ emission using data collected from experimental trials and predicted by a model (UNFCCC, 2014) in supplemented heifers grazing low quality *Chloris gayana* pasture in northwestern Argentina (Semiarid Chaco Region).

## Materials and Methods

**Data set*:*** Twenty eight braford heifers grazing *Chloris gayana* (Rhodes grass) were subjected to supplementation treatments based on corn (70%) and soybean expeller (30%) at 1.3% liveweight -LW- for two grazing cycles (GP) of 21 days (collected data) during winter 2013 (Period 1**[**GP1**]**: June; Period 2**[**GP2**]:** August). Each period had 4 replicates with 7 animals (n=28). FI (kg dry matter -DM- animal day $^{-1}$) was determined from fecal output and diet digestibility -DMD-. Fecal collection was made for 7 days of each period on selected animals grazing individual subplots. Diet digestibility was estimated using the acid detergent insoluble ash (ADIA) as internal marker. Simultaneously, initial and final forage availability and plant fractions (leaf, stem, and dead material) were measured above and below the grazing level (17 cm). Forage digestibility and crude protein concentration (CP) was determined at each grazing layer. Deferred forage quality decreased ($p<0.01$) as dry season progresses (P2 = late dry season). Chemical composition of forage had the following values: 74 – 64 g $Kg^{-1}$ CP, 330 – 347 g $Kg^{-1}$ NDF and 701 - 677 g $Kg^{-1}$ ADF for June (P1, pre-deferred forage) and August (P2, deferred forage), respectively.

**Data from model:** Methane emissions were estimated for each individual animal with the methodology used by the Commonwealth of Australia (2014) for the Australian Greenhouse Gas Accounts as submitted to the United Nations Framework Convention on Climate Change (UNFCCC, 2014). This methodology uses the equation from Minson and McDonald *[1] (1987) to predict daily FI (kg DM / animal. day). The methane emissions were calculated by using the equation reported by Kurihara (1999) and corrected by Hunter (2007) for tropical cattle*[2].

*[1]. $FI= (1.185 + 0.00454 \times LW – 0.0000026 \times LW^2 + 0.315 \times LWC)^2 \times MA$.
*[2]. $CH_4 = [kgCH_4 / animal.\ day = 34.9 \times FI – 30.8 / 1000]$.
Data were analyzed using linear mixed models, with the statistical software INFOSTAT (Universidad Nacional de Córdoba, Argentina) with its interface with R. Differences between means were tested using LSD Fisher ($P< 0.05$).

## Results and Discussion

Feed intake obtained by experimental data and predicted by model was not different in GP1. On the contrary, significant differences were observed in GP2 although FI data obtained by both data sources showed a lower variability than animal performance (Table 1). Predicted FI was only 6% higher than observed FI in GP2 and 2% lower in GP1. Consistently, González *et al*., (2014) have shown that frequently collected LW data (daily) provide more accurate time estimations than intermittent measurements. Methane emission expressed by $CH_4$ kg $ADG^{-1}$ (intensity) was not different between observed and predicted data in both cycles, probably due to the intraespecífic variation between animals in terms of growth, but also we observed a $CH_4$ increment in GP2 (forage completely death, see experimental details) when heifers achieved less growth than GP1. Emission expressed in $CH_4$ (g an day$^{-1}$) were 1% and 8% higher using predicted FI data for the GP1 and GP2, respectively. In the same way, emission expressed in $CH_4$ (g kg DMI$^{-1}$) showed less variation (<2%) in both grazing cycles. Although the low data variability, significant differences were found in GP2 for both $CH_4$ expressions, this fact shows the influence of FI data on methane emission estimations. The proportion of gross energy intake yielded as $CH_4$ (Y) was predicted accurately by both predicted and observed FI data sets. No differences were observed in GP1 unlike the GP2.

**Table 1:** Descriptive statistics for cattle measurements (LW, DMD and ADG), intake and methane emissions predicted by feed intake (FI) data set from an experimental trial and a model.

| | *Grazing cycle 1* | | | *Grazing cycle 2* | | |
|---|---|---|---|---|---|---|
| Variable | **Mean** | **s.d.** | **CV (%)** | **Mean** | **s.d.** | **CV (%)** |
| Inicial weight (kg) | 206,30 | 10,47 | 5,07 | 233,36 | 12,65 | 5,42 |
| DMD (g Kg DM$^{-1}$) | 683,50 | 64,50 | 9,40 | 580,22 | 6,67 | 11,33 |
| ADG (g day$^{-1}$) | 690,00 | 300,40 | 44,23 | 550,50 | 210,00 | 38,55 |
| Intake (kg an day$^{-1}$) | | | | | | |
| Observed | 5,04 a | 0,36 | 7,07 | 4,98 b | 0,44 | 8,93 |
| Predicted | 5,09 a | 0,54 | 10,57 | 5,33 a | 0,47 | 8,72 |
| Intake (% LW) | | | | | | |
| Observed | 2,35 | 0,18 | 7,10 | 2,05 | 0,18 | 8,73 |
| Predicted | 2,37 | 0,23 | 10,37 | 2,19 | 0,19 | 8,20 |
| Y | | | | | | |
| Observed | 6,35 a | 0,17 | 2,75 | 6,56 a | 0.09 | 1,42 |
| Predicted | 6,32 a | 0,26 | 4,78 | 6,47 b | 0.10 | 1,49 |
| CH4 (g an day$^{-1}$) | | | | | | |
| Observed | 145,22 a | 12,47 | 8,57 | 142,91 b | 15,51 | 10,85 |
| Predicted | 146,96 a | 18,47 | 12,78 | 155,36 a | 16,22 | 10,45 |
| CH4 (g kg DMI$^{-1}$) | | | | | | |
| Observed | 28,76 a | 0,44 | 1,53 | 28,66 b | 0,55 | 1,92 |
| Predicted | 28,78 a | 0,69 | 2,39 | 29,08 a | 0,52 | 1,80 |
| CH4 (g kg ADG$^{-1}$) | | | | | | |
| Observed | 258,19 a | 172,64 | 66,87 | 284,41 a | 118,93 | 41,82 |
| Predicted | 249,17 a | 132,47 | 53,16 | 303,38 a | 97,67 | 32,19 |

## Conclusion

Utilizing the UNFCCC model provides accurate methane estimation based on LW and ADG data in these experimental conditions. However, feed intake variations (especially during dry season) captured by experimental trials have strong influence on methane estimations, and was not always reflected by intermittent collected cattle LW data.

## References


Commonwealth of Australia. 2014. National inventory report 2012. Vol. 1. Available at http://www.environment.gov.au/system/files/resources/6b 894230-f15f-4a69-a50c 5577fecc8bc2/files/national-inventory-report2012-vol1.pdf.

González, L. A., E. Charmley and B. K. Henry. 2014. Modelling methane emissions from remotely collected live weight data and faecal near-infrared spectroscopy in beef cattle. *Animal Production Science* 54 (12):1980-1987.

Hunter, R. A. 2007. Methane production by cattle in the tropics. *The British Journal of Nutrition* 98: 657.

Kurihara, M., T. Magner, R. A. Hunter and G. J. McCrab. 1999. Methane production and energy partition of cattle in the tropics. *The British Journal of Nutrition* 81: 227–234.