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Enteric Methane Estimation with TIER 2 Compared to Results Obtained in a Field Experiment with Water Buffaloes Supplemented with Palm Kernel Cake in the Amazon Biome

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Introduction

The increase in greenhouse gases (GHG) concentration in the atmosphere has become steeper, which is attributed to anthropic activities. In Brazil, the productive sector indicated as GHG emitter is related to soil use, agriculture, and livestock. In 2014, the Brazilian agriculture and livestock emission represented about 20% of the overall GHG emission (SEEG, 2016). Particularly in livestock farming, one of the main GHG emission factors pertains to methane (CH_4) coming from ruminants enteric fermentation, which account for 68% of the emissions in the livestock sector (BERCHIELLI et al., 2012).

CH_4 emission by ruminants represents loss of part of the energy ingested by the animals. Some factors impact this emission, such as the quality and amount of food intake, digestive system, and animal

age. Different strategies have been planned to reduce GHG emissions by livestock, involving activity, nutritional, and reproductive management (BERNDT, 2012). Nutritional strategies are evaluated to decrease emissions such as supplementing ruminant diets with lipids. It was observed that, for every 1% of fat added to the diet, CH_4 production per kg of dry matter consumed decreases by up to 6% (ABDALLA et al., 2008).

Methodologies are tested to assess GHG emissions, such as employing mathematical equations to estimate enteric methane emissions. The Intergovernmental Panel on Climate Change (IPCC) has developed equations that allow ranking methane production into TIER 1, TIER 2, and TIER 3 depending on information such as animal characteristics and feed.

This study aimed to estimate enteric methane emissions using TIER 2 considering the same diet used in a field trial using sulfur hexafluoride (SF_6) as tracing gas in female buffaloes that consumed different levels of palm kernel cake in the Amazon biome.

Material and Methods

TIER 2 equations were used considering the same diet used in the field trial to quantify enteric methane emission by the SF_6 tracing gas technique according to methodology described by Johnson et al. (1994). These field trial data were obtained by the PECUS Project and belong to the database of the doctorate thesis of one member of the research team. It is worth pointing out that the field data were obtained at the "Senador Álvaro Adolpho" Animal Research Unity, belonging to Embrapa Eastern Amazon, in the city of Belém, Pará, Brazil. The diets were provided to 24 crossbred Murrah and Mediterranean female buffaloes, whose mean weight of 514 ± 69.88 kg, belonging to the Embrapa Eastern Amazon's experimental herd. The study was approved by the Committee of Animal Ethics – CEUA under protocol 007/2015. The animals were managed in confinement

(tie stall) and spent 21 days adapting to the experimental diets with free access to water and mineral mix. The experiment followed a completely randomized design with four treatments and six repetitions: In this study, only three treatments were considered, i.e., palm kernel cake inclusion in relation to body weight (BW) at the levels of 0% (T1), control; 0.5% (T2); and 1.0% (T3). All treatments were added with 0.15% (BW) wheat bran as palatability agent and corn silage was used as roughage. The animals were individually fed twice a day (8 AM and 5 PM). The amounts of silage were weighed daily and adjusted to achieve daily leftovers of up to 10%.

Those diets were used to estimate the emission factor adopting the methodology developed by the IPCC (IPCC, 2006), called TIER 2. Characteristics of the animals and diets were considered such as: animal age, initial weight, mean weight, weight gain, digestible energy, and gross energy.

Results and Conclusions

The results of enteric methane emissions presented in Table 1 show that the means in the control treatment with addition of 0.5% palm kernel cake did not differ according to Tukey's test at 5% probability. TIER 2 can be used as an estimator of enteric methane emissions when the diet's nutritional composition is known. The measurements with SF_6 in the treatment with 1% BW were below the estimates with TIER 2, which confirms that the tracing gas methodology is accurate to assess enteric methane emissions in animals fed the diet with the highest level of palm kernel cake inclusion. These results corroborate that adding fat to the diet reduces CH_4 production per kg of dry matter consumed by ruminants (ABDALLA et al., 2008). The highest emission was identified in animals in the control treatment, i.e., which received no palm kernel cake. The results show that TIER 2 was able to estimate enteric methane emissions for diets with up to 0.5% BW inclusion for female buffaloes since the results did not differ statistically between the two methods analyzed.

Table 1 – Estimated and measured values of enteric methane in beef water buffaloes fed with different levels of palm kernel cake inclusion in relation to body weight.

Evaluation method	Palm kernel cake inclusion levels		
	T1	T2	T3
TIER 2 (kg.year^{-1})	58.08 (±2.85) aA	57.79 (±2.73) aA	57.23 (±4.85) aA
SF_6 (kg.year^{-1})	78.16(±33.13) aA	62.46 (±27.15) aA	27.65 (±3.60) bB

Different letters in the same row differ ($p<0.05$) by Tukey's test.

Enteric methane emission estimated by TIER 2 had values close to those measured with the SF6 tracing gas technique up to 0.5% BW lipid supplementation, but values were overestimated for lipid supplementation at 1.0% BW. Therefore, TIER 2 can be used to calculate ruminant emissions in the Amazon biome since most of the herd in the region is reared in extensive ranching. Another noteworthy aspect is that the tracing gas methodology requires trained labor, laboratory structure, and a structured research team, such as PECUS Network.

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