58ª REUNIÃO DA SBZ
ZOOTECNIA PARA SEGURANÇA ALIMENTAR
E SUSTENTABILIDADE CLIMÁTICA

August 12th to 16th,

Greenhouse gas emission intensity in tropical climate dairy systems

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Modern dairy farming is associated with major sustainability challenges, among the main ones being the emission of greenhouse gases (GHGs) into the atmosphere. Dairy activity accounted for approximately 3% of Brazil's GHG emissions in 2020, with 72% of emissions accounted for in processes before and during primary milk production. Considerable effort has been made to measure these emissions to outline GHG mitigation and neutralization strategies. Therefore, the objective of this experiment was to evaluate the GHG emission intensities from enteric fermentation, manure and feed acquisition production by lactating cows in the herd, considering different production systems: unconfined (UC) and confined (C). Visits were made to 18 properties to apply questionnaires and collect data. The methodology used in this study was based on the guidelines of the National Greenhouse Gas Inventory, the Intergovernmental Panel on Climate Change and the Fourth National Inventory of Anthropogenic Emissions and Removals of Greenhouse Gases. Linear models were used to test the effect of production systems. The variables of interest (y) followed a normal distribution (Shapiro-Wilk test). Confidence intervals were estimated using Type II Wald chi-square tests. Data processing and analyses were performed in R using RStudio software. No significant difference was observed for the emission intensity from enteric CH_4, with the mean for UC systems being 5655.40 kg CO_2eq/lactating cow/year and C systems averaging 5660.14 kg CO_2eq/lactating cow/year. Similarly, no difference was observed for feed production and acquisition, where UC systems had an average of 4288.70 kg CO_2eq/lactating cow/year and C systems had an average of 3779.47 kg CO_2eq/lactating cow/year. The emission intensity of manure showed a difference between the production systems, being lower for UC properties (p=0.0257 - mean 1839.18 kg CO_2eq/lactating cow/year) compared to C properties (mean 2660.74 kg CO_2eq/lactating cow/year). In C systems, manure accumulates in confined areas, favoring anaerobic decomposition, which results in higher emissions of CH_4 and N_2O compared to UC systems. In addition, it was found that the largest source of GHG emissions in dairy systems was enteric CH_4 (average 47.4%), followed by feed production and acquisition (average 33.8%) and finally manure (average 18.8%). Thus, it is concluded that manure in C systems emits more GHGs. In addition, regardless of the production system, the largest emission source comes from enteric CH_4.

Keywords: dairy cow, climate change, manure management.

Acknowledgments: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq); Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.