

## ***In vitro* Methane Production of Plants Species from the Pampa Biome in Southern Brazil**

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### **Introduction**

The Brazilian grazing cattle herd of ca. 209 million animals is one of the world's major sources of enteric methane. Natural grasslands in southern Brazil cover ca. 13 million hectares with a unique mixture of species interacting in a spatial-temporal fashion (Boldrini et. al., 2010). In the Pampa biome, intensification in pasture use reduced methane emissions per unit of weight gain (Moscat, 2015). The reason for this reduction is unknown; however, it appears related to pasture structure, grazing behavior, diet selection, and differences in the chemical composition of forage species. These factors modify the quality and quantity of the dry matter consumed by animals with impact on fermentation and methanogenesis. Knowing the methanogenic potential of forage species in complex pastoral systems is important in developing grazing strategies capable of reducing methane emission intensity. The objective of this study was to assess the *in vitro* methane emission and fermentation characteristics of major Pampa biome forage species.

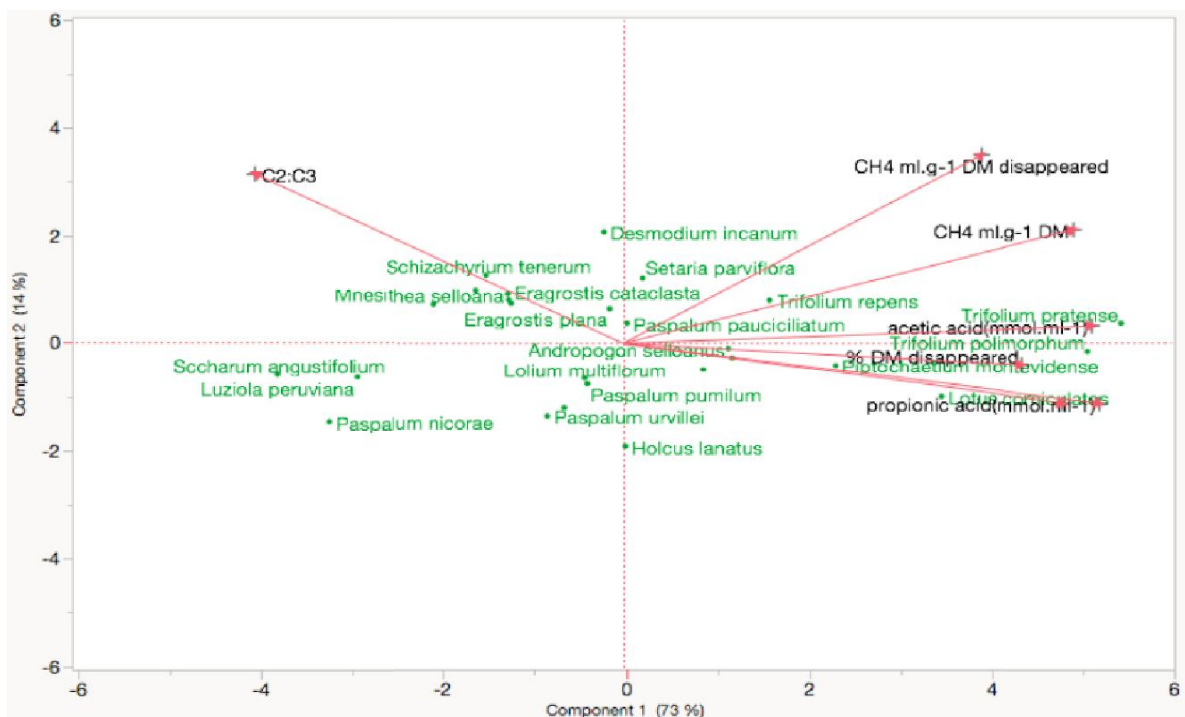
### **Materials and Methods**

The experiment was conducted at Embrapa South Livestock, Bagé, in the state of Rio Grande do Sul, Brazil, during three years (2009, 2011, and 2012). Twenty-one grass species: *Andropogon selloanus*, *Axonopus affinis*, *Cynodon dactylon*, *Dichantherium sabulorum*, *Eragrostis cataclasta*, *Eragrostis plana*, *Holcus lanatus*, *Lolium multiflorum*, *Luziola peruviana*, *Melica rigida*, *Mnesithea selloana*, *Paspalum nicorae*, *Paspalum notatum*, *Paspalum pauciciliatum*, *Paspalum pumilum*, *Paspalum urvillei*, *Piptochaetium montevidense*, *Saccharum angustifolium*, *Schizachyrium tenerum*, *Setaria parviflora*, *Sporobolus indicus*; and five legumes *Desmodium incanum*, *Lotus corniculatus*, *Trifolium polymorphum*, *Trifolium pretense*, *Trifolium repens*. of major occurrence were collected and transplanted to a greenhouse, using three boxes (replicates) per plant. Plants were collected at two phenological stages: bloom (F) and vegetative (V). Plant samples were dried at 60°C for 72 hours and ground to pass through a 1-mm sieve for the *in vitro* assay. The *in vitro* methane procedure was performed according to Mould et al. (2005). At 24 h of incubation, gas pressure was measured then 5 ml samples of headspace gas were transferred to a extainer tubes for subsequent analysis of methane concentration by gas chromatography. Also, DM disappearance (%), methane (ml g<sup>-1</sup> of DM degraded) and VFA production (µmol ml<sup>-1</sup> of acetate, propionate, and butyrate) were measured. Data were analyzed by principal component analysis (PCA) for all parameters and evaluated species (Figure 1) using JMP Pro 12 software (version 12.0.1).

### **Results and Discussion**

Principal component 1 explained 73% of the variation in CH<sub>4</sub> production, while component 2 only explained 14% of the variation in CH<sub>4</sub> production for major forage species from the Pampa biome (Figure 1). The species Loco had the best fermentation characteristics in terms of high DM disappearance, high

VFA production and low methane ( $\text{ml g}^{-1}$  of DM degraded). Others like Trpr and Trpo were similar at these parameters, but had higher methane emission. The least methanogenic species were Scan and Pani; however, they did not have desirable fermentation characteristics. A lower acetate to propionate ratio is desirable as higher propionate is associated with reduced methane synthesis. Species with lower acetate:propionate (C2:C3) ratio were Scte, Mnse, Erca and Erpl. It is important to note that this is the first time that these species were analyzed for the parameters presented in this paper and this can be considered a great advance to understanding the grasslands of South America.



**Figure 1. Principal components analysis for *in vitro* methane production and fermentation characteristics of major species in the Pampa biome.** Component 1:  $\text{CH}_4$   $\text{ml g}^{-1}$  DM incubated, DM disappearance, concentration ( $\mu\text{mol.ml}^{-1}$ ) of acetic, propionic and butyric acids. Component 2:  $\text{CH}_4$  ( $\text{ml.g}^{-1}$  of DM disappeared), C2:C3 ratio.

## Conclusions and Implications

This analysis characterized the degradation of the major forage species in the Pampa biome in regard to *in vitro* methane emissions and fermentation. From this study, it should be possible to select species with low  $\text{CH}_4$  emissions for future studies on pasture or for *in vivo* digestibility trials.

## References

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