52ª Reunião Anual da Sociedade Brasileira de Zootecnia

Zootecnia: Otimizando Recursos e Potencialidades

Belo Horizonte – MG, 19 a 23 de Julho de 2015

Consumo e emissão de metano de bovinos em pastagem natural do Sul do Brasil[1]

Teresa Cristina Moraes Genro[2], Bruna Moscat de Faria[3], Ênio Rosa Prates[4], Alexandre Berndt[5], Ian Cezimbra[3], Cimélio Bayer[6], Paulo César de Faccio Carvalho[7]

[1]Parte da tese de doutorado do segundo autor, financiada pela EMBRAPA (MP1 PECUS)
[2]Pesquisador A, Embrapa Pecuária Sul- CPPSUL, Bagé, RS. e-mail: cristina.genro@embrapa.br
[3]Doutoranda PPG Zootecnia da Universidade Federal do Rio Grande do Sul- UFRGS, Porto Alegre, RS. Bolsista da Capes. e-mail: bmzoorural@gmail.com e ian_zootecnia@hotmail.com
4 Professor Visitante do Departamento de Zootecnia da UFRGS. e-mail: rosa30@terra.com.br
[5]Pesquisador A, Embrapa Pecuária Sudeste- CPPSE, São Carlos, SP. e-mail: alexandre.berndt@embrapa.br
[6] Professor Associado do Departamento de Solos da UFRGS. e-mail: cimelio.bayer@ufrgs.br
[7] Professor Titular do Departamento de Plantas Forrageiras da UFRGS. e-mail: pcfcarvalho@ufrgs.br

Resumo: Objetivou-se com este estudo avaliar a emissão de metano e o consumo a pasto de bovinos de corte em terminação em pastagens naturais em diferentes estações do ano. Foi realizada uma avaliação em cada estação do ano de de 2013. A determinação do consumo foi feita utilizando n-alcanos e da emissão de metano através da técnica do hexafluoreto de enxofre (SF_6). O consumo de matéria seca, expresso em quilos e em percentagem do peso vivo, apresentou os maiores valores durante o inverno, e o menor foi durante o outono. Na primavera também foi observado menor valor de consumo em porcentagem do peso vivo. A maior emissão de metano total e por quilo de matéria seca consumida foi na primavera, comparada às outras estações do ano, com valor 94.32% maior que o valor médio de emissão das demais estações. Consumo de matéria seca e emissão de metano de bovinos de corte em terminação em pastagens naturais sofrem maior influência da estação do ano, do que de ferramentas utilizadas para melhorar a qualidade ema produtividade do pasto como a fertilização e a sobressemeadura com espécies exóticas.As pastagens naturais, quando bem manejadas, apresentam potencial para produzir carne de qualidade com baixos valores de emissão de metano, reduzindo o impacto ao meio ambiente.

Palavras–chave: alcanos, bioma Pampa, gases efeito estufa, fertilização, hexafluoreto de enxofre, sobressemeadura

Intake and Methane Emission of beef cattle on natural pasture in Southern Brazil

Abstract: The objective of this study was to evaluate methane emission and dry matter intake (DMI) of finishing beef cattle on natural pastures in different seasons. The study was conducted in an area of Embrapa Southern Region Animal Husbandry, Bagé, RS. We did four evaluation, one at each season of the year 2013. The dry matter intake was measured by n-alkanes, and methane emissions by the sulfur hexafluoride technique (SF_6). The dry matter intake in kilograms and as a percentage of body weight showed the highest values during the winter, and the lowest, in the fall. In the spring was also observed lower intake value as percentage of body weight. The highest methane emission, overall and per kilogram, of dry matter consumed was in spring, with a value 94.32% higher than the average emission value of the other seasons. DMI and methane emission of beef cattle finishing in rangelands suffer more influence of the season, than tools used to improve the quality and productivity of pasture as fertilization and oveseeded with exotic species. Natural grasslands when well managed presents potential to produce quality meat with low values of methane emission reducing the impact to the environment.

Keywords: alkanes, fertilization, greenhouse gases, overseeded, Pampa biome, sulfur hexafluoride

Introduction

In Brazil, 90% of beef cattle production is pasture-based (Hoffmann et al., 2014); however, due to the large territory and climate and vegetation differences, the type of pasture and the production systems used change and thus the quantity of methane emitted per kilogram of food intake and/or kilogram of meat produced may vary from system to system. Therefore, evaluation of the amount of methane emitted becomes necessary to know the real impact of the Brazilian cattle industry on global methane emissions. Among the various Brazilian biomes is the Pampa biome, the main production base of beef cattle in Rio Grande do Sul (Nabinger et al., 2000). Then, the challenge is to manage this native pastures promoting both animal production, and maintaining the ecosystem and low emissions of greenhouse gases. Despite growing concern about the increase in emissions of greenhouse gases, there are few Brazilian data about the subject. Thus, the aim of this study was to evaluate methane emission and dry matter intake of finishing beef cattle on natural pastures in different seasons.

Material and Methods

The study was conducted at Embrapa Southern Region Animal Husbandry, located in Bagé, RS. The soil from the area chosen to allocate the treatments is the LUVISSOLO Háplico Pálico abrúptico class. Two ~7 ha pastures were assigned to each of three treatments: natural grassland (NG), natural grassland fertilized with nitrogen (NGF) and natural grassland fertilized with nitrogen and overseeded with *Lolium multiflorum* and *Trifolium pratense* (NGFS). Treatments were established in the area in 2005. In August 2012, 27 Hereford steers averaging 10 months and weighing 180 kg were introduced into the area to finishing,, three in each paddock. The grazing method was continuous with variable stocking rate with enough animals to keep the herbage allowance on 12 kg of dry matter (DM).100 kg^{-1} of body weight (BW; 12% BW). The experimental design was a totally randomized design, with three replications area. All seasons were evaluated in the year 2013: summer (January 21), fall (April 29), winter (July 22) and spring (October 28).

Three animals per paddock were dosed twice daily (at 8 am and 4 pm) with cellulose pellets containing 200 mg of dotriacontane (C_{32}) and this was administrated for 10 days in each season. From the fifth to de 10^{th} day of dosing, faeces samples were collected per rectum simultaneously to the administration of C_{32}.

The faeces samples from six days of collection, per season and per animal, were thawed, homogenized and it was made a sample for each animal for season. After drying, the faeces were ground in a Willey mill of 1 mm sieve, identified and stored for later analysis of alkanes. To estimate the amount of forage consumed by the animals, the simulated grazing technique was applied between the 5 th and 8th day of C_{32} administration period. After collection, samples were dried at 55 $^{\circ}$ C for 72 h, ground and used for the following analyses: DM at 105 $^{\circ}$ C for 12 hours; organic matter (OM) by burning in a muffle furnace at 550 $^{\circ}$ C, neutral detergent fiber (NDF) without the use of amylase. The gross energy (GE) was determined by bomb calorimetric. The determination of n-alkanes in forage and in faeces samples followed the methodology described by Dove and Mayes (2006).

Methane emissions were measured using the sulfur hexafluoride (SF6; Johnson et al*., 1993*) technique by stainless collecting tubes connected to the animals nostril during five days in each evaluation. After collection, the vessel was pressurized with nitrogen and methane concentrations and SF_6 were then determined using gas chromatography. The capsules of SF_6, placed in the rumen of animals, showed average permeation rate of 2.62 (± 0,46) mg day^{-1}.

Data were subjected to analysis of variance for repeated measures and F test by the statistical program JMP (JMP version 9.0.0, 2010). Means were compared using the Tukey test at 5% significance level.

Results and Discussion

The levels of pasture improvement, NG, NGF and NGFS, did not affect the parameters evaluated (P>0.05). However, the variables studieds were influenced by the season. Therefore, we present in the Table 1, the results for each season.

There was no difference in the NDF intake only, which averaged 3.92 kg day^{-1} (Table 1). The dry matter intake in kilograms and as a percentage of body weight showed the highest values during the winter, and the lowest was in the fall. In the spring we also observed lower intake value as percentage of body weight. The highest overall methane emission and per kilogram of dry matter consumed was in the spring, compared to other seasons, with value 94.32% higher than the average emission value of the other seasons. Rearte and Pordomingo (2014) stated that as the animal productivity increases, methane emissions per animal are also higher due to higher DMI , but if we consider the methane emission expressed as kg of CO2-eq.kg^{-1} carcass weight, this value will be reduced. Indeed, during spring, animals were heavier and had the highest weight gain rate observed.

On the other hand, the botanical composition of the pasture could have affected the methane emissions during the spring, as the natural pasture has a great species diversity, and the proportion of these species can vary throughout the year and/or among different years. In addition, the large presence of inflorescences in the pasture in spring can also influence these emissions. However, as of yet, there is no screening of the methane emissions of the different species that compose the native pasture, and it is difficult to know whether this explanation applies.

The higher gross energy intake was observed in winter and the lowest was in the spring. Gross energy intake in the winter was 20.81% higher than in the spring. In the spring, we also observed greater percentage of daily methane emitted related to the NDF and gross energy intake, with no difference in the values observed in the other seasons. It is important to emphasize that despite the higher energy loss as methane in the spring, a value that exceeded the average 2-12% of the lost energy intake as methane (Johnson et al., 1993), the animals showed the largest weight gain . When we consider the amount of methane emitted per kilogram of weight gain, we observed the lowest values in spring and summer (195.33 and 176.31 g CH_4 kg GPV^{-1}, respectively).

No difference was observed (P>0.05) in kg CH4 emission.animal-1.year-1, with means values of 31.60 ± 7.31, 42.87 ± 6.93 e 46.33 ± 7.31 to NGF, NGFS and NG treatments, respectively. It is important highlight that the average values to methane emissions per animal are below the proposed values by the Intergovernmental Panel on Climate Change (IPCC, 2006) for this animal category. Data published by IPCC showed as a reference value for methane emissions by beef cattle in South America 56 kg per animal per year.

Table 1. Dry matter intake (DMI, kg), DMI per 100 kg of animal body weight (% BW), daily methane emission per animal (g animal^{-1} day^{-1}), methane emissions per kilogram of dry matter consumed (g kg^{-1} DM), neutral detergent fiber daily intake (NDFI kg day^{-1}), gross energy daily intake (GEI kg day^{-1}) and methane emission value per neutral detergent fiber (% NDFI) and gross energy intake (% GEI), by season.

	Summer	Fall	Winter	Spring	SD^{+}	P
Intake (kg)	5.35AB	5.19B	6.13A	5.25AB	0.24	0.0321
Intake (% BW)	1.99AB	1.76B	2.18A	1.77B	0.08	0.0018
CH_4 (g.animal^{-1} day^{-1})	141.05B	132.52B	142.29B	269.36A	15.09	<0.0001
CH_4 (g kg DM^{-1})	26.36B	25.53B	23.21B	51.31A	5.97	0.0007
NDFI (kg day^{-1})	4.03	3.93	4.20	3.52	0.17	0.0829
GEI (MJ day^{-1})	90.89AB	87.04AB	101.11A	80.07B	5.00	0.0356
% NDFI	36.71B	37.03B	34.46B	87.07A	8.45	0.0002
% GEI	8.14B	8.35B	7.19B	17.29A	1.75	0.0010

Means followed by different capital letters in the same row differ by Tukey test (P<0.05). +SD= Standard Deviation

Conclusions

DMI and methane emission of beef cattle finishing in rangelands suffer great influence of the season.

The impact of seeding and fertilization on DMI and methane emission remains to be tested.

Natural grasslands when well managed presents potential to produce quality meat with low values of methane emission reducing the impact to the environment.

Acknowledgements

The research leading to these results has been conducted as part of the Pecus project which received funding from Macroprograma 1 (EMBRAPA) under the Number 01.10.06.001.08.00.

References

Dove, H. and Mayes, R. W. 2006. Protocol for the analysis of n-alkanes and other plant-wax compounds and their use as markers for quantifying the nutrient supply of large mammalian herbivores. Nature Protocol 1(4):1680-1697.

Hoffmann, A.; Moraes, E. H. B. K.; Mousquer, C. J.; Simioni, T. A.; Gomes Junior, F.; Ferreira, V. B. and Silva, H. M. 2014. Produção de bovinos de corte no sistema de pasto-suplemento no período seco. Nativa Agriculture Environmental Research 2(2):119-130.

IPCC. 2006. Agriculture, Forestry and Other Land Use In: Eggleston, H.S., L. Buendia, K. Miwa, T. Ngara, and K. Tanabe. Guidelines for National Greenhouse Gas Inventories,4. IGES, Japan, 32.

Johnson, D. E., Hill, T. M., Ward, G. M., Johnson, K. A., Branine, M. E., Carmean, B. R., Lodman, D. W., 1993. Ruminants and other animals. p.219–229. In: Khalil, M. A. K., (Ed.), Atmospheric, methane: sources, sinks, and role in global change. Springer-Verlag,Berlin.

Nabinger, C.; Moraes, A. and Maraschin, G.E. 2000. Campos in Southern Brazil. p.355–376. In: Grassland Ecophysiology and Grazing Ecology. ed. Lemaire, G.; Hodgson, J.; Moraes, A.; Nabinger, C. and Carvalho, P. C. F. CAB International.

Rearte, D. H. and Pordomingo, A. J. 2014. The relevance of methane emissions from beef production and the challenges of the Argentinean beef production platform. Meat Science 98(3):355-360.