How are the methane emissions in beef steers grazing natural grassland in southern Brazil?

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Introduction

Natural grasslands are the main feed basis for beef cattle production systems in Southern Brazil. It are the main feed basis for beef cattle production systems in Southern Brazil. It is characterized by a great diversity of species with approximately 3000 rangeland species only in Rio Grande do Sul state (Setubal and Boldrini, 2010). However, one of the most distinct characteristic of this rangeland is the co-existence of C_3 and C_4 species (Overbeck et al., 2007). The data about methane emission in this environment are few. This work aimed evaluating methane emission (CH_4) per animal and live weight gain per area (LWG. ha^{-1}) by finishing beef steers on natural grasslands with different levels of intensification.

Material and Methods

The experiment was carried out at Embrapa Southern Livestock, Bagé, RS, Brazil. Three plots of 7 ha natural grasslands were assigned to each of the three treatments: (i) natural grassland (NG); (ii) NG plus fertilization (NGF): 35 kg ha^{-1} P_2O_5 and 50 kg N ha^{-1}, twice a year;

every year between 2005 to 2014; and (iii) NGF plus overseeded with *Lolium multiflorum* and *Trifolium pratense* (NGFS). Pastures had been under continuous grazing by yearling Hereford steers with constant intensity of 12 kg forage DM per 100 kg live weight. Three "test" animals (nine animals per treatment) were in the paddocks for a whole year and grazing intensity was adjusted with other steers. The "test" animals entered in the area in July of 2014, and had average weight of 230 ± 14 kg in winter and 284 ± 20 kg in spring. Methane emissions (CH_4, g.day^{-1}) were measured using the sulfur hexafluoride (SF_6) technique. Evaluations were made in 2014, in the winter (August, 4-9), and spring (December, 1-6). The animals were weighted each 28 days to determine live weight gain per hectare (LWG.ha^{-1}). Analysis of variance were performed by JMP (JMP Pro version 12.0.1, 2050). Means were compared using the Tukey test with 5% of significance.

Table 1. Percentage contribution of the main species found in the experimental area based on survey of flora in spring of 2014.

Species	NG	NGF	NGFS
Axonopus affinis	14.14 %	11.59%	17.42%
*Cynodon dactilon**	0.07%	9.22%	0.82%
*Eragrostis plana ness**	30.13%	26.56%	18.78%
Holcus lanatus	0.04%	1.29%	8.37%
*Lolium multiflorum**	0.03%	1.26%	12.89%
Paspalum notatum	4.74%	4.49%	6.59%
Saccharum angustifolium	3.97%	1.09%	6.62%
Sporobulus indicus	2.14%	5.78%	1.77%
*Trifolium pretense**	-	-	0.01%
Others	33.21%	29.97%	25.08%
Dead material	11.53%	8.75%	1.65%

*Exotic species

Results and Conclusions

No interactions was observed for any of the variables. There was effect of season and treatment for methane emission per day and per year. Higher CH_4 emission was observed in spring than in winter (190 ± 8 g and 173 ± 5 g CH_4, respectively). Among treatments, the highest CH_4 emission was in NGFS (Table 2). Faria (2015) also observed higher methane emission in natural grassland overseeded in spring compared to others seasons. This probably occurs due to fast forage growth in this time and its high nutritive value. Cezimbra (2015) evaluating methane emission by heifers on natural grassland in different seasons also observed increased methane emission during the spring, in two consecutive years. The author attributes this result to the difference in dry matter intake by animals and the structural changes that occurs in the pasture at this time. The amount of methane emission per year founded in this paper was higher than that related by Genro et al. (2014) and this may be due to the differences in animal emission or due to differences in the nutritive value of the pasture in different years.

There was effect only for treatment in the average daily gain and live weight gain per area. The highest ADG and LWG was observed in NGF, and the lowest in NG. Faria (2015) related that fertilization improves the nutritional quality of the forages causing animals in that environment had better quality diet, thus being able to meet their daily nutritional requirements and more. This year there was high precipitation, and furthermore, the winter was mild, without presenting very low temperatures for long periods. These conditions along with the nitrogen addition in the soil may have favored the growth of plants in time where little dry matter accumulation occurs, thus resulting in weight gain of the animals (Faria et al., 2016). No difference was observed for methane emitted per kilogram of live weight gain per day, with average of 0.245 kg CH_4 kg LWG^{-1} day^{-1}.

Table 2. Methane emission per animal per day (g d^{-1}) and by year (kg $year^{-1}$), average daily gain (ADG, kg d^{-1}) and live weight gain per area (LWG, kg ha^{-1}) in natural grassland (NG), natural grassland fertilized (NGF) and natural grassland fertilized and overseeded (NGFS).

Treatments	CH_4 Emission (g d^{-1})	Kg CH_4 $animal^{-1}$ $year^{-1}$	ADG (kg d^{-1})	LWG (kg ha^{-1})
NG	170.95±7.99 b	62±3 b	0.298±0.06 b	73±16 b
NGF	176.03±7.57 ab	64±3 ab	0.555±0.06 a	136±15 a
NGFS	201.29±9.37 a	73±3 a	0.488±0.07 ab	117±18 ab

Means that are followed by different letters differ (P<0.05) by Tukey test. Means presented are followed by standard deviation.

The fertilization in natural grasslands had potential to produce more meat without increasing methane emission, proving to be a good alternative to improve productivity without causing greater impact to the environment.

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