Enteric methane emission of Nellore cattle in extensive grazing or integrated systems

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Introduction

Brazilian beef cattle production is primarily based in grazing systems which in general present low productivity as a result of extensive monoculture pastures. Integrated systems come up as alternatives to overcome this scenario which in turn may have impacts on agricultural greenhouse gas emission. In 2015, we reported the first results on enteric methane (CH4) emissions comparing extensive and integrated systems (Gomes et al., 2015). However, it is important to observe how results behave over time, in order to draw robust conclusions. The aim was to evaluate the enteric methane emission of beef cattle grazing extensive pastures (EXT), integrated crop-livestock (ICL) and crop-livestock-forest systems (ICLF) in two seasons, over a two-year study.

Material and Methods

The experiment was carried out at Embrapa Beef Cattle Research Center, in Campo Grande, MS, Brazil (20°24' S, 54°42'W, 560 m asl) in 2014 and 2015. Nellore heifers were submitted to different grazing systems as follow: EXT – *Brachiaria decumbens,* established in 1992/1993, ICL – 3 years *Brachiaria brizantha* cv. BRS Piatã, following

no-till soybean crop and ICLF - 3 years *Brachiaria brizantha* cv. BRS Piatã, following no-till soybean crop, in an area with 227 trees/ha, *Eucalyptus urophylla x E. grandis* planted in 2009. Twelve Nellore heifers were used per year and randomly allotted to one of six paddocks (1 to 1.5 ha), two paddocks per system. The enteric methane was measured throughout two seasons every year (February/Summer and August/Winter). Experimental animals had 442 ± 23 kg live weight (LW) and 30 mo of age in Summer 2014, 501 ± 34 kg LW and 36 mo of age in Winter 2014, 271 ± 14 kg and 18 mo in Summer 2015 and 382 ± 22 kg and 24 mo in Summer 2015. The CH4 was measured using the SF6 tracer gas technique, according to Primavesi et al. (2004) over a minimum 5-day period each season. The effects of year, season, treatment (system) and

interactions were analyzed using a mixed model with repeated measures and means were compared using Tukey-Kramer adjusted test ($p < 0.05$).

Results and Conclusions

There was an interaction between year, season and system effects ($p < 0.01$), therefore results were presented within years. The CH4 emission was much greater in 2014 than in 2015 (183 vs 118 g $head^{-1}$ d^{-1}, $p < 0.0001$). This may be related to differences in age and live weight of the heifers across years, as in 2015 the heifers were younger and lighter than those used in 2014. However, the main explanation for differences in CH4 emission across years may be laid on differences in pasture availability. For instance, considering the summer season, the ICL and ICLF systems presented 4.3 and 3.6 ton forage dry matter per hectare in 2014, respectively (Gamarra et al., 2014), whereas the availability decreased to 2.2 and 1.2 ton in 2015, respectively (unpublished data). Differences in pasture availability may have affected dry matter intake which in turn may have led to differences in CH4 emission between 2014 and 2015.

Enteric methane emissions were greater in the summer compared to winter, irrespective the year (Table 1). In average, the differences between seasons were about 9%. The reasons for this results may be the same those explain the differences for CH4 emissions across years as it is expected a lower forage availability during the winter in the Brazilian Cerrado conditions.

Table 1. Least square means for enteric methane (CH_4) emissions (g $head^{-1}$ day^{-1}) of Nellore heifers in different grazing systems and seasons

Season	System			Mean	Coefficient of variation, %
	Extensive	Integrated Livestock-Crop	Integrated Livestock-Crop-Forest		
		2014			
Summer	196a	189a	189a	191A	5.19
Winter	158c	197ab	170bc	175B	6.73
		2015			
Summer	127a	115a	128a	123A	5.00
Winter	132a	108a	100a	113B	5.76

Different small letters within roll and capital letters within columns differ at 5% probability for Tukey-Kramer adjusted test.

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In 2014, there were no differences for CH4 emissions during the summer, with an average of 191 g^{-1} d^{-1} head. Conversely, during the winter, ILC system had a greater CH4 emission followed by ICLF and EXT. In turn, in 2015, no differences across systems were observed for both summer and winter. As explained before, forage availability may affect dry matter intake and, in turn, CH4 emission. Therefore, this may explain why the differences across systems

observed in 2014 were not observed in the following year. In conclusion, differences in CH4 emission among grazing systems, including extensive and integrated systems (ILC and ILCF), may exist; however they seem to be mainly driven by the effects of forage availability within systems which, in turn, may vary as a function of climate factors and of pasture management (e.g. stocking rate).

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