Methane emissions of beef cattle in four Brazilian grazing systems

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Introduction The global demand for food will increase in the next decade (FAO, 2011) and Brazil plays an important role in this scenario, especially in animal protein supply. The challenge for future food production systems will be to reconcile the necessary increase in productivity, driven by increased demand, with more efficient production and distribution, reducing waste production while satisfying the growing concern for environmental sustainability. In a context of global economic crisis and food insecurity, the intensification of livestock production in tropical grazing areas should be based on the best use of the potential of pasture growth. The aim of the present study was to evaluate if different levels of intensification of grazing systems can be used as mitigation strategies for enteric methane emissions. These results are from the PECUS Research Network, a multi-institutional project conceived by EMBRAPA with the objective of obtaining the necessary data, using internationally accepted research protocols, to support governmental policies and to contribute to the development of mitigation alternatives for GHG emissions.

Material and methods The study was conducted at the experimental station of the Brazilian Agricultural Research Corporation (EMBRAPA), located in São Carlos, São Paulo state, in the southeast of Brazil. 24 Nellore steers, 12 months old and weighing 265.2±9.1kg in average, were distributed in four representative Brazilian grazing systems, in January 2012: irrigated pasture with high stocking rate (IHS) and dryland pasture with high stocking rate (DHS), covered by *Panicum maximum* since 2002; dryland pasture with moderate stocking rate (DMS) and degraded pasture (DP), covered by *Brachiaria decumbens* since 1996. HIS and DHS systems were composed of 12 paddocks each under rotational grazing with occupation period of 3 days and 33 days grazing intervals. The DMS system had 6 paddocks with occupation period of 6 days and 30 days grazing intervals. DP system was managed under continuous stocking. The plots were limed, corrected with superphosphate to achieve 20mg/dm^3 P and potassium chloride to achieve 4% K in cation exchange capacity. Top-dressing fertilization with nitrogen was applied at the rate of 600 kg N/ha.year in HIS, 400 kg N/ha.year in DHS and 200 kg N/ha.year in DMS. Degraded pasture was not fertilized. The complete experimental period will be from January 2012 to August 2013. Animals will be kept in the same grazing systems from weaning until slaughter and will be evaluated for performance, growth efficiency, carcass and meat quality. During the experimental period emissions of CH_4 and N_2O, as well as the carbon incorporation in soils, will be evaluated once in each season, providing the GHG balance of the four systems. This abstract shows the Spring season methane collection that occurred in October 2012, in the end of the dry season, using the SF_6 tracer technique (Johnson *et al.*, 1994). Animals were dosed with permeation tubes with an average load of 1423.3 ± 67.6 mg of SF_6 and average emission rate of 1.20±0.35 mg/d. Each animal received two permeation tubes five days before the start of the collections. Samples were collected every 24 hours for five consecutive days. Gases were analyzed on a Shimadzu GC 2014. Data were analysed using GLM procedure of SAS and averages were compared with Tukey test. Treatment differences were considered significant at $P < 0.05$.

Results Methane emissions, per animal per day, were higher (P < 0.05) in the intensive and irrigated system - HIS - but this system also allowed higher (P < 0.05) live weight gain (LWG) and stocking rate than the others (Table1). Considering the stocking rates, the HIS system emitted four and a half times more methane than the degraded pasture, but the production of body weight was also seven times greater. Methane emissions per LWG per hectare were not significantly different.

Table 1 Different production systems effects on methane yields

	Production systems					
	HIS	DHS	DMS	DP	s.e.d	P
Methane emission (gCH_4/d)	211.9^a	163.6^{ab}	165.6^{ab}	119.1^b	9.4	0.0033
Live weight (LW; kg)	434^a	410^a	420^a	352^b	7.6	<0.0001
Daily gain (LWG; g/d)	552.5^a	338.0^b	243.8^b	307.4^b	35.3	0.0015
Stocking rate (AU/ha)	3.73^a	1.53^b	0.90^d	1.17^c	0.24	<0.0001
Methane emission (gCH_4/ha)	777.1^a	227.7^b	139.8^b	109.5^b	64.3	<0.0001
Daily gain (gLW/d.ha)	1992.2^a	515.8^b	221.4^b	361.7^b	165.8	<0.0001
Methane emission (gCH_4/gLWG.ha)	0.479^{ab}	0.449^{ab}	0.765^a	0.306^b	0.058	0.0247

Conclusions Considering the end of the dry season, with limitations of sunlight, temperature and rain, improved pastures did not express their full production potential, but the HIS system partially benefitted by irrigation, allowed higher daily gain per hectare. Although there is a higher demand for inputs in the more intensive systems, one hectare of well managed pasture can substitute seven hectares of degraded pasture, producing meat with the same methane emission.

Acknowledgements The authors gratefully acknowledge the support of employees and students of Embrapa Southeast Livestock and funding from Embrapa and CNPq.

References

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