Proc. Aust. Soc. Anim. Prod. 2014 Vol. 30

Enteric Methane Emission by Holstein, Gyr and F1 Holstein-Gyr Dairy Heifers

T. Silvestre[A], L.G.R. Pereira[B], P.H.M. Rodrigues[A], F.S. Machado[B], T.R. Tomich[B], M.M. Campos[B], G.B. Santos[C], M.W. Vargas[D], E.M. Almeida[E] and B.C. Mata e Silva[F]

[A] University of São Paulo/USP-FMVZ-VNP, Pirassununga/SP, Brazil, 13635-900
[B] Embrapa Dairy Cattle, Juiz de Fora/MG, Brazil, 36038-330
[C] Fluminense Federal University (UFF), Niterói/RJ, Brazil, 24220-008
[D] University of José do Rosário Vellano (UNIFENAS), Alfenas/MG, Brazil, 37130-000
[E] State University of Santa Cruz (UESC), Ilhéus/BA, Brazil, 45662-900
[F] Federal University of Minas Gerais (UFMG) Belo Horizonte/MG, Brazil, 30.161-970

Methane (CH_4) is characterized as a major of greenhouse gases (GHG) contributing about 15% of global warming, and is directly related to the efficiency of rumen fermentation and the consequent loss of energy in production systems (Cotton and Pielke 1995). Brazil is one of the largest producers of livestock worldwide. It has a large and stable domestic market and is a major world exporter of animal products. In order to enhance Brazil's participation in understanding and reduce global livestock GHG emissions the Research Network PECUS was created (Greenhouse Gases Dynamics in Brazilian Livestock Production Systems). One of the PECUS component projects is RumenGases, which focuses on enteric methane emissions from ruminants and as part of RumenGases project, this study was carried out at experimental station of Embrapa Dairy Cattle, Minas Gerais State, Brazil. Thirty six heifers were used: 12 Holstein breed, 12 F1 Holstein x Gyr and 12 Gyr breed, weighing 200 kg on average, housed in tie-stalls, with individual feed bunks and drinkers. Experimental diets were fed in different amounts, based on maintenance intake predicted by NRC (2001): high level – 2 times maintenance intake; moderate level – 1.5 maintenance intake; and low level – maintenance intake. Roughage (corn silage) and concentrate were fed as total mixed ration, twice daily and the amount was adjusted according to the animal's live weight. The sulphur hexafluoride (SF_6) tracer technique was used to measure enteric CH_4 emission, assessed throughout the last five days of the experimental period of 90 days, every 24 hours, after morning meal. Concentrations of CH_4 and SF_6 were determined by gas chromatography; the flow of methane released per animal was calculated from the known release rate of SF_6 in the rumen and from the concentrations of methane and SF6 in the measured gas samples, compared to the flow of SF_6 measured. Experimental design was completely randomized in factorial (breed of cattle x level of consumption). Data were submitted to analysis of variance, the means were compared using Tukey's test ($P < 0.05$) and a correlation study was done using the Pearson's correlation coefficient. The results shown in the Table 1 indicated that that dry matter intake was positively correlated to daily production of CH_4 (r=0.73, $P < 0.01$).

Table 1. Effect of breed of dairy heifers and level of intake on daily enteric methane emissions per unit of metabolic body weight (g/kg$^{0.75}$) and per kilogram of dry matter intake (g/kg) or per body weight gain (g/kg).

Breed	Level of intake					
	Low		Moderate		High	
	g/kg$^{0.75}$	g/kg	g/kg$^{0.75}$	g/kg	g/kg$^{0.75}$	g/kg
Holstein	1.3^{a}	34.9^{a}	1.6^{a}	27.2^{ab}	3.7^{a}	48.3^{a}
Holstein x Gyr	1.0^{a}	27.7^{ab}	1.4^{a}	23.2^{b}	2.1^{b}	29.4^{b}
Gyr	1.4^{a}	42.7^{a}	1.9^{a}	38.6^{a}	2.0^{b}	28.2^{b}
CH_4 per body weight gain (g/kg)	1.6		0.3		0.2	

Means followed by different letters in the same column differ by Tukey's test ($P < 0.05$).

In the high level of intake, Holstein heifers showed higher ($P < 0.05$) CH_4 emission per unit of metabolic body weight (3.7 g/day) and higher ($P < 0.05$) CH_4 emission per kilogram of dry matter intake (48.3 g/kg). In this same level of intake, Gyr and F1 Holstein x Gyr heifers showed similar ($P > 0.05$) CH_4 emission per unit of metabolic body weight (2.0 and 2.1 g/day, respectively) or per kilogram of dry matter intake (29.4 and 28.2 g/kg, respectively). Independent for the level of intake, there was no significant variations among breeds for emission of CH_4 per kilogram of body weight gain, the means values of emission were 0.2, 0.3 and 1.6 g/kg for high, moderate and low level of intake, respectively.

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This work was funded by CNPq, FAPESP and SEG.
Email: tainasilvestre@usp.br

ANIMAL PRODUCTION IN AUSTRALIA

Proceedings of the 30th Biennial Conference of the Australian Society of Animal Production

Volume 30

Harnessing the Ecology and Physiology of Herbivores

Edited by
S. Hatcher, G.L. Krebs and B.W.B. Holman

National Convention Centre, Canberra, Australian Capital Territory
8-12 September 2014